FARM SCIENCE

IN WAR AND PEACE

IMPERIAL MYCOLOGICAL INSTITUTE
1945

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS
RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

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FARM SCIENCE
in
WAR and PEACE

The 65th ANNUAL REPORT of the New Jersey State Agricultural Experiment Station and the 57th ANNUAL REPORT of the New Jersey Agricultural College Experiment Station, 1943-44

RUTGERS UNIVERSITY
NEW BRUNSWICK NEW JERSEY

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Letters of Transmittal

To His Excellency, Walter E. Edge,
Governor of the State of New Jersey:

My Dear Governor Edge:

I have the honor to submit herewith the Sixty-fifth Annual Report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10, 1880, and which is Chapter 106 of the laws of that year.

Yours sincerely,

JAMES ANDREWS, *President*
Board of Managers

New Brunswick, N. J., July 31, 1944.

To His Excellency, Walter E. Edge,
Governor of the State of New Jersey:

My Dear Governor Edge:

I take pleasure in presenting to you, in behalf of the Trustees of Rutgers College in New Jersey, under which is conducted the Rutgers Scientific School, the New Jersey State College for the Benefit of Agriculture and the Mechanic Arts, the Fifty-seventh Annual Report of the State Agricultural Experiment Station. This report is submitted in accordance with an act of Congress, approved March 2, 1887, and with an act of the Legislature of the State, approved March 5, 1888.

Yours sincerely,

ROBERT C. CLOTHIER, *President*
Rutgers University

New Brunswick, N. J., July 31, 1944

Report of the Director

THE year 1943-44 was a period when farmers and those who serve them kept their noses to the grindstone, concentrating time, energy, and ingenuity on the immediate task of producing record-breaking quantities of food and fiber to support the armies and arsenals of the United Nations. In retrospect, it seems that this period may have been the turning-point in the agricultural war effort, and that the critical period of production may have been passed on the farm front as it has on most salients of the industrial front.

Still Need Production

This does not mean that efforts can be relaxed. The pressure for production will remain acute as long as our men are fighting on distant battle fronts; in some respects it may become even more acute as they move to greater distances from the source of supply. But it seems safe to assume that only a catastrophic turn in the weather or a serious labor shortage can expose us again to the risk of "too little and too late," so far as farm products are concerned. This does not mean that the farmers' wartime problems are solved. Great difficulties still confront them, particularly the shortages of labor and machinery, but the hard work and ingenuity which have sustained their efforts thus far will help them materially in overcoming whatever obstacles may appear as the war continues.

New Jersey farmers have contributed their share to the Nation's peak outpouring of crops and livestock. Taking the 1935-39 average as 100, their 1943 production of milk stood at 112; eggs 146; tomatoes for processing 128; white potatoes 122. The most phenomenal increase has taken place with the strategic soybean, where acreage for 1943 was 220 per cent higher than the 1935-39 average.

Helps City People Too

The brief accounts of research activities that make up the body of this report speak more eloquently than any adjectives of mine can do of the the part played by the Experiment Station in helping farmers to produce more with less. They tell, too, of the growing list of non-agricultural services performed by this institution—of aid in the fight on malaria, of progress in the treatment of sewage and industrial wastes and the control of pollution, of promising developments in the production of potent new antibiotic substances from soil organisms. Of some projects nothing can be said in print at this time. Suffice it to say that the war record of the Experiment Station will reflect credit on the state we serve.

Many Personnel Changes

As in previous wartime reports, I must record an extremely high rate of personnel turnover. The past year has been unusual in the number of changes in the higher ranks: the retirement of Dr. Thomas J. Headlee after a long and distinguished career as head of the entomology department; the loss of Charles S. Beckwith, who died as he had lived, in the service of the cranberry and blueberry growers; the resignations of Olin L. Lepard, associate dairy husbandman in charge of the Dairy Research Farm; of Roger De-Baun, veteran editor; of Kenneth W. Ing-

walson, energetic leader of 4-H clubs; of Harry W. Gehm, capable associate in water and sewage investigations; of many others whose services and friendship will be sorely missed.

Reorganization Underway

Reorganization, both external and internal, was prominent in our thoughts during the year. The New Jersey Commission on State Administrative Reorganization, recommending a program for the educational agencies, called for incorporation of the Experiment Station with all branches of Rutgers University in a new and enlarged State University of New Jersey. So far as the Experiment Station is concerned this proposal, which awaits legislative action, would merely serve to put the seal of official sanction on the complete coordination of its activities with those at the College of Agriculture that has prevailed since 1880.

Editorial Offices Merged

Within the institution, the editorial offices serving the Extension Service were merged with those serving the College of Agriculture and Experiment Station. The great breadth and increasing specialization of activities that have evolved under the general heading of soils and crops led to the division of this work among three independent departments: soils, under Dr. Firman E. Bear; farm crops, under Dr. Gilbert H. Ahlgren; and microbiology, under Dr. Selman A. Waksman. Although they were in opposite directions, both steps bid fair to strengthen the work of the institution.

Despite their strict attention to the task in hand, farmers and their co-workers have found time for consideration of the trends that will be set in motion when the period of demobilization begins. Postwar planning stands high on the agenda of agricutural groups all the way from the communities and counties through the states to the U. S. Department of Agriculture. This activity will unquestionably be pushed during the coming year.

One fact seems clear: the best we can do in maintaining full employment, in promoting better diets, increased foreign trade, and new uses for farm products cannot reasonably be expected to support overall farm production at the current wartime rate. The basic problem for American agriculture after the war, therefore, will be to devise some orderly means of adjusting production downward without bringing on a 20-year agricultural depression like the one that followed the first World War.

New Techniques Coming

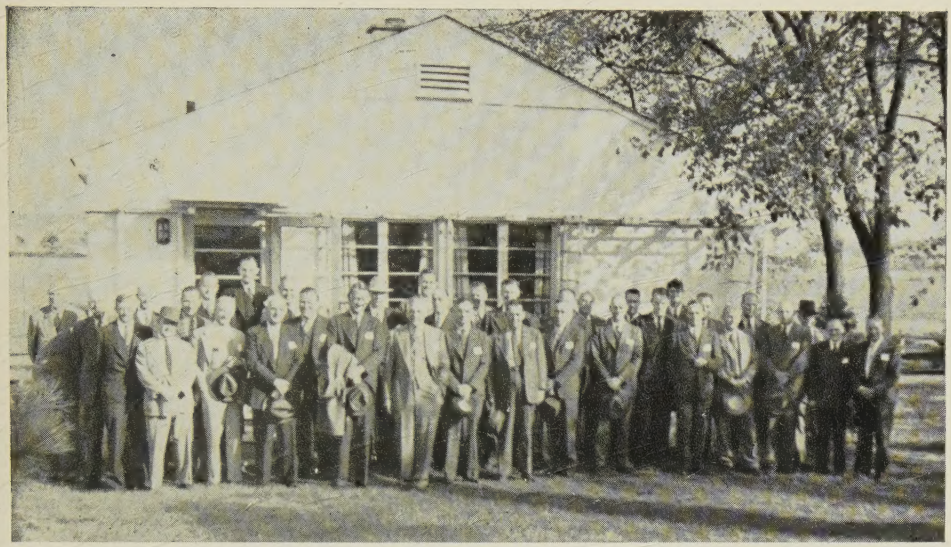
Wartime developments will have marked effects on postwar agriculture. There will be new methods of processing and transportation, new types of machinery, new techniques in all phases of production and distribution. As these developments are applied, there will be shifts in centers of production which will tend to modify the competitive position of every farmer in the country.

It is generally agreed, for example, that some of the present land area and manpower devoted to cotton production will have to be diverted to other uses. What will these other uses be? There are some indications that dairy farming and vegetable production will be substantially increased in the old-time cotton belt. Obviously, developments in this area are of vital concern to the farmers of New Jersey.

Competition for agricultural markets after the war will be keener than ever before. The marginal or inefficient producer faces a losing struggle. The greatest security for New Jersey farmers lies in their record of efficiency, of alertness to adopt new and improved methods. To maintain their leadership, they will have need of more and better research, research on new problems as well as on those with which we are already familiar.

Irrigation Will Increase

One such problem arises in connection with irrigation. There is every reason to expect that irrigation will increase tre-



Under the leadership of the Experiment Station, these experts hope to revolutionize the design of farm buildings.

mendously in New Jersey after the war. This prospect raises many questions. What is the effect of constant artificial watering on the soil? Can we apply plant nutrients through our irrigation pipes? Can we link irrigation with disease and insect control? Are our supplies of underground water adequate to justify farmers in making the relatively large investment involved in irrigation? Urban dwellers and industrialists are already concerned about water supply —the problem is equally vital to agriculture.

This is but one of many complex problems calling for research. We need more information about the processing of fruits and vegetables, about dairy manufactures, about soils and fertilizers and soil fumigants. We must continue to breed new and better types of plants and animals. We must be more alert to economic trends affecting agriculture.

Need Better Buildings

A substantial part of a farmer's investment, particularly in livestock and poultry farming, is tied up in buildings. How well do these buildings serve the purposes for which they are intended? How economically are they built? There is good reason to believe that neither functionally nor economically is the subject of farm building design and construction on a sound scientific basis. Rutgers and the New Jersey Station are fortunate in having an opportunity to enlist the land grant colleges in a nationwide attack on this problem, to be inaugurated during the 1944-45 fiscal year. This will be a long-time program, but if our hopes are realized, both the intermediate and the final results will be valuable contributions to agriculture in the years ahead.

Many other problems cry out for study. Still others will appear with the passage of time. The future of research is bright, and the New Jersey Experiment Station will have its share of opportunities to better the lot of mankind. Knowing its staff, I have no fear that it will be found wanting in the difficult years to come.

W. H. Martin

We're Learning More About The Soils of New Jersey

SOIL, like faith, is the substance of things not seen. Other than mankind itself, it is the most important resource of the State and Nation. Field surveys of the soil and careful studies of the means by which it can best be conserved are essential to public welfare. Such surveys, and the supplemental studies associated therewith, cannot be completed in a year, or even a century, but must be continuous. For soil changes with time and use, and the intensity of its use increases with the growth of population. Before the white man discovered the United States, only about 800 thousand Indians roamed its forests and prairies. Now our soil must provide for 170 times that many people, to say nothing of the food shipments required to be sent abroad.

Erosion Threatens New Jersey Soils

The need for soil conservation in New Jersey is apparent from the deep gullies that have developed in many cultivated fields where inadequate measures have been employed in erosion control. But many of the evils of erosion are not so readily apparent to the eye. Exact measurements of erosion effects and of the resulting reduction in productivity are being made, therefore, at the Marlboro Soil Conservation Experiment Station. Soil losses under continuous cultivation of the land amounted to 8,900 pounds per acre annually, in comparison with an average loss of only 4,200 pounds when a hay crop was introduced once in three years. The productivity of land was found to be closely correlated with the amount of the original topsoil still remaining in place.

Among the many methods that are employed to control erosion, those designed to maintain a high level of organic matter in the soil are receiving special attention. A large number of field tests are being made in southern New Jersey of the effect of resting the land by growing soil-improving crops for a whole year for plowing under, by the use of winter cover and catch crops, and by the application of hauled-in material, such as sawdust and salt hay.

Organic Materials Tested

In a comparison of 24 different organic materials that are being used at the rate of 2½ tons dry weight per acre annually in conjunction with 1,000 pounds of 5-10-10 fertilizer in the growing of snap beans, it was found that cultivated peat, peat moss, and cornstalks were the most effective, and pine shavings and salt hay the least. Bean yields were greatly reduced following the growing of sweet clover, no matter whether the roots alone or the entire crop was plowed under. The yield of snapbeans was nearly ten times as large following the plowing under of mixed weeds as after a pure stand of sorrel. The evidence indicates that these bad effects are the result of the presence of some toxic substance in these materials, either naturally or as a result of their decomposition in the soil. Resins, coumarin, and oxalic acid are believed to be the responsible agents in the shavings, sweet clover and sorrel, respectively. Other studies indicated that salt hay contains so much common salt as to make its use objectionable under some conditions. The answer to this difficulty lies in exposing the hay to the leaching action of the ra

Land area mapped on the basis of land-use capabilities.

for some weeks before it is used.

Analyses of sewage sludges indicated an average content, on an oven-dry basis, of around 1.5 per cent nitrogen, 1.5 to 2.0 per cent phosphoric acid, and 0.2 to 0.3 per cent potash. Their contents of dry matter, on the wet basis, vary between 15 and 45 per cent, and their pH values lie between 6.5 and 7.5. Used at the rate of 10 tons per acre on the corn crop, sludge has been found to be about as effective as an equal amount of cow manure.

Synthetic Manure

In a study of the production of composts from various types of plant materials, it was found that a high-quality artificial manure comparable to composted cow manure can be prepared from cornstalks within a period of 3 months. Good-quality products were prepared within 4 to 6 months from cereal straw. Resistant materials, such as salt-grass hay and woody residues, required much longer periods for proper decomposition. Tree and shrub trimmings and other woody materials should not be mixed with ordinary plant refuse because of the slowness with which they decompose. Such products should be built into a special manure pile and allowed to decompose for a longer time. Composts from peat and leaves should be considered only as soil conditioners. They will, however, make high-quality manures if reinforced with inorganic fertilizer. The residual effect of the composts produced from cow manure, cornstalks, and cereal straw was much greater than that of inorganic fertilizer. These results were checked both by greenhouse and field tests.

Vitamins in Composted Materials

Many plant materials are attacked by microorganisms. This is particularly the case with those which are added to the soil, but applies as well to certain animal

feeds such as silage and materials used as human foods like sauerkraut and cheese. It can be expected that the vitamin content of these materials will become altered as a result of microbial development, in the light of results recently obtained in the microbiology laboratories. Three of the B-vitamins, riboflavin, pantothenic acid, and nicotinic acid were included in the study.

Vitamins Soon Lost

In some cases there was an increase in the vitamin content of the decomposed material during the first few days of decomposition. The percentage increases were greater with vitamin-poor materials such as straw than with other materials like grass which had a relatively high initial vitamin content. After the brief period of initial increase in the amounts of vitamins, there was a loss and in many cases the rate of loss was more rapid than decomposition of the organic material as a whole. Consequently, the final composted product had a lower vitamin content than the plant material from which the compost was prepared.

It has been established that plants are able to absorb vitamins through their root systems, but it remains to be determined whether or not appreciable amounts of vitamins are absorbed and, if so, whether these produce superior plants. In any case the results indicate that one should not expect composted material to be richer in vitamins than fresh plant residues and it seems unlikely, therefore, that benefits obtained from treatment of soil with composts are due to any appreciable extent to the vitamins contained in them.

Tile Drainage Needed

Many areas on New Jersey farms could be made more productive through installation of tile drainage systems or through reclaiming present systems installed many years ago. Lowland areas with a high subsoil water table can often be made useful as pasture and for cropping through tile drainage, provided suitable outlets are available. Many springy areas on slopes can be drained effectively through the use of tile employed in the form of cutoff or intercepting drains.

Tile Drainage Is Old

Tile drainage in the United States is more than a hundred years old and many areas on New Jersey farms that were successfully tiled a half century ago are gradually receding to the marginal stage through depreciation of the original tile system. New Jersey is unique in the universal use of the horseshoe type tile, both the open and closed bottom types having been universally employed in the old system. Modern hexagon or round tile, however, do not require a board underlay, and installation is less expensive and simpler. In most instances, a progressive system of tile installation is recommended by the Extension Service. Essential lines are placed so that a year's observation of performance will indicate where additional lines are necessary, thus avoiding the cost and labor of installing an unnecessarily complete system in the initial layout. Each year approximately one thousand acres in area throughout the state are surveyed, lines staked out and detailed instructions on drainage and installation provided for individual farm systems.

A New Soil Survey

The original soil survey, completed some years ago, was made on a scale of 1 inch per mile. This gave a useful picture from state and county viewpoints, but the maps lacked the detail required for consideration of the soil problems on individual farms and of the several fields on them. Now, through the cooperation of the Soil Conservation Service, the soils of the state are being mapped on a scale that allows 8 inches per mile, and some 1,600,000 acres have been surveyed on this basis. These surveys indicate not only the soil type but the slope, degree of erosion, and present land use. With this physical in

Crown vetch in a Burlington County apple orchard.

ventory a new yardstick, called "land-use-capability," has been developed as a measure of the type of cropping to which a given field may safely be put.

Peat Resources Cataloged

A survey of the state's peat resources, supported by funds from the WPA, was 70 per cent completed when the WPA was discontinued. The results have now been published, in the form of two bulletins, by the State Department of Conservation and Development. They throw a clear light on the nature of New Jersey's peat resources and their possible utilization.

As a result of this survey, covering 364,000 acres formerly classified as bogs, swamps, or marshes, it has been established that the peat areas of the state can be divided into three groups; namely, the northern peats, which are predominantly of the sedge and reed types; the Coastal Plain peats, predominantly of the forest type; and the salt marshes and the alluvial peats. No true sphagnum peat is found in New Jersey, although growing sphagnum is found very extensively over the bogs. Among the forest peats, the "cedar swamps" are particularly characteristic.

Fitting Fertilizer Practice to the Soil

In general, all New Jersey soils when put to intensive use have been found to require liberal applications of complete fertilizer. On the heavier types most or all of the fertilizer can be applied a few days in advance of planting or along the row at planting time. On the sandier types, however, better results were obtained by smaller applications frequently repeated during the growing season. The problem is one of storage, the sands having much less "exchange" capacity for fertilizer elements than the loams.

Virtually all the nonlimestone soils of the state have been shown to be naturally acid and in need of lime, once they are put into production. Those of limestone and calcareous-shale origin, such as the Hagerstown and Dutchess, were found to contain an abundance of lime in their subsoils, and, for that reason, are better suited to such deep-rooted, acid-sensitive perennials as alfalfa, than are those derived from noncalcareous rocks. This is on the assumption that their subsoils are well drained, as indicated by a yellow, red, or brownish color.

Potassium Studies

The potassium needs of 20 important New Jersey soils have been intensively studied. It was found that Lakewood sand, Whippany silty clay loam, Sassafras sand, Gloucester loam, and Papakating stony loam had the greatest need for this element, and Dutchess shale loam, Bermudian silt loam, Dover loam, Penn silt loam, and Collington loam the least, the other 10 soils being intermediate in their potassium requirements.

Studies of the mineral composition of alfalfa in relation to the soil on which it was grown showed that on soils that are

high in available potassium this crop may absorb three or four times as much of this element as it needs; its content of calcium and magnesium being correspondingly reduced. This points to the need of heavy applications of lime in preparation for the crop and annual applications of potassium as required. Otherwise there is a waste of the relatively costly potassium. Furthermore, when the alfalfa takes up large amounts of potassium at the expense of calcium, its mineral-feed value is greatly reduced, the calcium requirements of animals being high whereas their need for potassium is low.

Boron Findings

Considerable attention was paid to the trace elements, deficiencies of which are becoming more and more serious as the soils grow older agriculturally and as the economic need for higher acre yields increases. Thus boron, an element that is required in such small quantities that deficiencies in it were unknown until recently, was found to be deficient in 12 per cent of the soils of the state, and considerable amounts of borax, the primary source of this element, are now being used, especially for such crops as alfalfa, turnips, beets, radishes, and cauliflower.

Since this survey was completed the question has frequently been raised as to whether or not the fertilizer practices or the liming practices on the agricultural soils of the state in any way influence the effectiveness of boron in supplying the needs of the plants. Through careful investigation by the use of controlled plant cultures at the Experiment Station, and supplementary observations in the field, the answer to this question is now available.

Careful study of tomatoes and corn grown in boron-deficient media (solution, sand, and soil culture) has demonstrated the fact that injury to the plants due to boron deficiency is much less severe at low levels of potassium than at high levels in the same medium. Injury is particularly severe when more potassium is present than is required for good growth. Calcium acts in the same way as potassium in this respect except that it is more effective than potassium in its capacity to intensify the symptoms of boron deficiency. Low boron with high calcium appears to be a deadly combination.

Injury to plants resulting from too much boron in the growth medium is also much more severe at high potassium levels than it is at low potassium levels. On the other hand, calcium has just the opposite effect. Boron toxicity is much more severe at low than at high calcium levels.

From Laboratory to Field

The practical aspects of these results may be stated briefly and in very simple terms as follows: If a soil is so deficient in boron that visible symptoms of deficiency occur on the plants grown on the soil, the application of potassium would tend strongly to intensify the injury to the plants already suffering from boron deficiency. The application of lime to this same boron-deficient soil would unquestionably magnify the injury sustained by the plants, the degree of injury depending upon the size of the application. These results have been observed both in the field and in artificial culture under controlled experimental conditions.

Would Intensify Injury

At the other extreme, if an agricultural soil has a boron content in excess of that required for good growth and development, so that visible symptoms of toxicity occur on the plants, the application of potassium would intensify the injury to the plants already suffering from boron toxicity, particularly if the quantity of potash applied should be in excess of that required for maximum yields. If, on the other hand, lime should be applied to this same soil, the injury sustained by the

This machine applies dry fertilizer and lime, or liquid fertilizer in the subsoil.

plants would be diminished and might be completely overcome, depending upon the size of the application of lime. These results also have been obtained in experimental cultures and observed in the field.

Another important fact relative to boron metabolism and boron relationships in different plants has been brought out by these studies. Whereas the potassium-boron and calcium-boron relationships are similar in all plants thus far investigated, it has become clear that the levels (concentrations) of the nutrient elements in question at which these interrelationships manifest themselves through visible injury to the plants, are markedly different for the two great classes of plants, the *dicotyledonous* (tomatoes, alfalfa, beets, beans, potatoes, etc.) and the *monocotyledonous* (corn, wheat, rye, oats, barley, grasses, etc.). Furthermore, there is a sharp line of distinction between these two great classes of plants with respect to their minimum boron requirements and their ability to endure excesses of this element. The *dicot* (tomato, alfalfa, etc.) has a very high minimum boron requirement and a very low resistance to excess boron as compared with the low minimum requirement and the very high resistance to excess boron of the *monocot* (corn, wheat, etc.). For example, corn will grow normally on a soil in which the boron content is totally inadequate for the growth of the tomato and other dicots. On the other hand, corn will also grow without injury on a soil which may contain enough boron to destroy the tomato plant.

Other Trace Elements

Strong evidence has been found that the Sassafras, Hagerstown, Merrimac, Glouces-

ter, and Lakewood soils are in serious need of magnesium, whereas the Dover, Whippany, Lansdale, Bermudian, and Fox are not. The other soils studied occupy intermediate positions with respect to this element.

Applications of radioactive material to the soil on which beets were being grown had no noticeable effect on the crop. The extent to which zinc, manganese, and copper are required to be supplied for maximum crop yields, or the degree to which they can be made to serve as crop stimulants, remains to be determined, but preliminary studies are under way.

The Role of Sand-Size Soil Particles

Certain essential plant nutrient cations, such as calcium, potassium, and magnesium, are held tightly or adsorbed on the surface of very small or colloidal soil particles. When plant roots come in contact with these colloidal particles, such adsorbed cations are released in a base-exchange process and are absorbed by the roots. This process provides an important source of plant nutrients.

Small particles have been considered to be chiefly concerned in this process because of their relatively large exposed surface area per unit weight as compared with that of large particles.

Recent experiments under controlled sand-culture conditions have shown, however, that certain types of particles separated from the soil and large enough to be classed as sand were able to hold and to release to plant roots unexpectedly large amounts of calcium, amounts which compared favorably with those supplied by very small soil particles. These sand-size particles apparently possessed a large total surface area because of their porous structure and differed greatly from ordinary solid particles which do not possess the property of adsorption to any considerable degree.

These results show that soil particles as large as sand, and hitherto considered relatively unimportant, may in some soils supply appreciable amounts of essential nutrients to plants. This fact may be important in the conservation and use by crop plants of fertilizers applied to the soil.

Ammonium Nitrate Tested

By reason of its growing economic importance as a fertilizer, special attention was paid to ammonium nitrate, a careful comparison of this material with other forms of nitrogen being made on pasture grasses. The increased yields produced by its use were about the same as those resulting from the application of sulfate of ammonia and urea, but not quite so large as were obtained with the same amount of nitrogen in the form of nitrate of soda. Similar tests of liquid ammonia dissolved in water showed that it tended to burn the grass, no matter whether applied during the middle of the day or in the evening, and that its effect on yield was relatively very small.

Fertilizer in Water

Recent findings favoring the application of fertilizer in water to vegetable crops led our vegetable department to design a machine for this purpose. Successful use of this distributor on large commercial fields brought requests for a similar device that would be suitable for small plots. For this purpose a 4-gallon tank was mounted on a two-wheel sulky similar to a large wheel hoe. The liquid flows through a tube to a cultivator tooth, which applies it alongside the row. The equipment is practical for areas up to 1 acre.

Equipment was built to apply regular fertilizer mixtures. The fertilizer is placed in the tank and circulated through a rotary pump which keeps it in suspension. Pipes are placed in the barrel in such a manner that the movement of solution prevents residues from settling out, so that the residue is applied uniformly with the solution. A gasoline motor drives the pump. Mounted on a tractor, the pump

No use to know it if you don't do it. This man not only knows soil conservation but he is using it to increase crop yields and income on his farm.

may be driven from the power take-off. This equipment eliminates the need for cisterns and tanks.

Equipment was also built to be mounted on a plow or subsoiler beam to apply fertilizer solutions on the bottom of the furrow or in the subsoil. One season's observations of the use of this equipment indicate that this method of application may have much use on vegetable farms in the future.

Sowing seed during dry weather always results in spotty germination. We have found that water or starter solution applied with the seed greatly improves germination, resulting in much more uniform stands. A commercial concern now offers equipment to apply this liquid as the seed is sown. This is the result of work in our vegetable department.

Saving Soil on the Farm

In themselves, studies designed to determine the relative effectiveness of various methods of soil conservation are of little value. They must be put into operation in actual farming. That is the purpose underlying the formation of four conservation districts in which landowners have banded together to develop effective conservation programs. These districts are governed entirely by the farmers themselves, who call upon local, state, and national agencies for help. During the past year these districts have reported the construction of 100 thousand lineal feet of diversion terraces, the adoption of contour cultivation on 1,641 acres, the establishment of contour strip cropping on 1,200 acres, and the building of complete terrace-systems on 151 acres. Nearly half a million trees were planted in reforestation projects. Thirteen counties are included within these conservation districts; in 12 of them full-time conservationists are now at work in cooperation with the county agricultural agents and the farmers whom they serve.

Extension Activities

The effectiveness of research is multiplied many-fold through the activities of extension specialists who piece together the observed practices of farmers and the findings of this and all other experiment

stations to develop a constantly improved consulting service. Thus the conservation specialist kept the need for erosion control before the farmers of the state, encouraged cooperative effort, and lent aid to numerous projects designed to improve soil management practices. His activities were extended to include reforestation programs, conservation of wild life, and construction of fish ponds, for both food and fun.

Similarly, the extension specialist in soils has cooperated with the county agricultural agents and with many individual farmers who have sought aid in the solution of their soil problems. During the year he has written some 2,500 letters, most of which had to do with soil problems. Reports were made on more than 3,000 samples of soil examined in the quick-test laboratory. Special studies included the use of sericea lespedeza, crown vetch, and birdsfoot trefoil as soil-improving crops, either for mulching or for plowing-under. A wartime project involved the experimental use of one carload of TVA ammonium nitrate that was applied to haylands and pastures on some 50 farms in Burlington County. Records on hay fields showed an average increase of 82 per cent from the use of 150 pounds of ammonium nitrate per acre. The actual increase was 1,790 pounds of hay per acre. The protein content of the untreated hay was 6.97 per cent and that of the treated hay 8.61 per cent. Similar marked improvement was noted on pastures, but data on actual yield increases are not yet available.

Plant Breeding Is Giving Us New Flavors, Higher Yields

WHETHER he eats plants, or whether he consumes animals that have been nourished and fattened on vegetation, man is utterly dependent upon plant life to convert the constituents of the soil into food and fibre for his use. More efficient production of plants, therefore, is a fundamental step in increasing and diversifying the food supply and thus raising the standard of living.

PLANT BREEDING

Not content with taking plants as he finds them, the plant scientist is turning more and more to the development of new forms that will better serve the purposes of mankind. Plant breeding has given us new flavors and consistencies, higher acre-yields, greater resistance to insects and diseases, to frost and drought.

Asparagus

Among the dozens of plant-breeding projects under way at the Experiment Station, each year sees significant milestones in a few. A highlight of the year under review was the harvesting of some 15 pounds of seed of a high-yielding strain of asparagus developed through a decade of careful selection and cross-breeding at New Brunswick.

About 2,500 plants of this strain were planted on a cooperator's farm in the summer of 1941. The plants have made an excellent showing in uniformity of type and vigor. Some 1,500 one-year old roots of the same strain were planted on the Vegetable Research Farm the following year and another 600 in 1943.

When a few more seed blocks have been established, we believe the strain will be worthy of naming and introduction for commercial use.

Sweet Corn

Sweet corn, grown on some 23,000 acres, is one of New Jersey's leading vegetable crops. The hybrid sweet corn breeding program inaugurated in 1942 has been greatly increased in scope during the past year. Much of this work is being carried on in Burlington County, the heart of the sweet corn section of the state.

A survey of conditions in Burlington County indicated that the most serious problems facing growers of sweet corn were caused by insect infestation, diseases, and unreliable seed. Smut, wilt, and the European corn borer were particularly serious.

A corn breeding program can do much to put sweet corn production on a more

Two good ears per stalk is one of the aims of the sweet corn breeding program.

profitable basis. During the past year more than 200 inbreds were tested for wilt resistance by means of artificial inoculation in the greenhouse. Inbreds showing susceptibility were discarded, leaving 168 to use in the breeding program. One hundred forty-two hybrids were made in 1943 on the breeding block in Burlington County and these hybrids are now under intensive study. Information is being gathered on the yield, quality, earliness, disease resistance, and other factors found in these new hybrids.

In addition to the program for the development of better hybrids, a hybrid seed production study is under way to determine the practicability of producing local hybrid seed. Two hybrids, Marcross and Old Hickory, are included in this study. The first year's results are very encouraging.

Atlantic Alfalfa

Atlantic alfalfa has been outstanding in its hay production capacity during the past 5 years in trials at the Experiment Station. It has consistently outyielded such varieties as Grimm, Kansas Common, Hardistan, Hardigan, and many others by as much as 500 pounds on the average of dry hay per acre each year. The characteristics which make Atlantic alfalfa superior are:

(1) It possesses a much branched root system which gives greater resistance to winter-heaving through better root anchorage;

(2) Average hay yields from this variety are 15 to 20 per cent greater than other common varieties with which it has been tested;

(3) It is longer-lived than most of the present commercial varieties;

(4) Seed is produced in abundance under favorable conditions, making it profitable for commercial seed purposes.

Foundation seed stocks of Atlantic alfalfa are being maintained at the Experiment Station. Foundation seed has also been sent to the West for increase purposes since seed crops are much larger and more certain in the West than they are in New Jersey. Seed of Atlantic alfalfa should be available for limited farm use in 1946.

Breeding Corn for Borer-Resistance

The corn borer is difficult to control by cultural means alone. Studies now underway promise some help through the breeding and development of borer-resistant hybrids.

In 1943, of 129 single-cross hybrids tested at the Experiment Station, 8 showed superior yielding ability but only 4 of these showed low stalk breakage due to borer injury. In a similar test involving inbred lines, A47 showed considerable resistance to the borer. It has apparently transmitted this characteristic to New Jersey Hybrids, 2, 4 and 5, of which it is one of the parents.

Based on stalk breakage counts, under natural conditions, N. J. Hybrid No. 5 showed strong resistance with 7 per cent breakage as compared to 31 per cent for N. J. No. 2, and 33 per cent for No. 4. When corn borer eggs were placed on the leaves of these hybrids to increase the infestation, reductions in grain yields resulted as follows: N. J. No. 5, 11.4 bushels per acre; N. J. No. 2, 2.8 bushels per acre; and N. J. No. 4, 1.0 bushel per acre.

While N. J. Hybrid No. 5 seems to have considerable resistance to borer entry into the stalk, it is damaged more severely than either Nos. 2 or 4 when such borer entrance occurs. Hybrids Nos. 2 and 4, on the other hand, are fairly tolerant of a borer population within the plants.

Strawberries

Ten strawberry selections, outstanding for vigor, productiveness, and flavor, were listed for rapid propagation after the 1944 harvest season. The best of these will be named after further tests, provided no serious faults are observed. More than 40,000 seedlings have been studied since the breeding work began and 1159 have been given a second test.

Progress in the development of better varieties of everbearing strawberries was

Two bushes of the Rancocas variety. The bush on the left yielded 1.8 quarts a year for 5 years, with good care but no fertilizer; bush on right yielded 5.7 quarts a year for 5 years, with same care, plus recommended fertilizer.

emphasized by the behavior of several selections which were especially vigorous, productive, and attractive during the fall of 1943. Three of these are being propagated for tests in various parts of the state.

Blueberries

The New Jersey Station is cooperating with the U. S. Department of Agriculture in breeding better blueberry varieties. About 50 selections from seedlings grown in New Jersey are now being given a second test and there are still some 5,000 seedling plants under first test in a five-acre planting near Weymouth. During the 1943 fruiting season a total of 32 varieties was marked for propagation. Rooted cuttings of these selections are now growing in the propagating frames and will be used to establish row tests on commercial blueberry farms. There has been a real need for very early and very late varieties and some of the seedlings now being propagated promise to fill that need better than anything previously available.

Peaches

The New Jersey Peach Council has already distributed more than 643,000 trees of Station-developed varieties ripening from the Golden Jubilee to the Afterglow season. In the spring of 1943, 29 different peach crosses were made from which 1,504 seeds were obtained. Fifteen different nectarine crosses were made and 471 pits obtained.

Fifty-three new yellow-fleshed peaches were selected during the summer of 1943 as having sufficient promise to be tested

against the present list of commercial varieties. Twenty-six new white-fleshed seedlings also showed considerable commercial promise.

The Peach Council has requested a peach that will have color and shipping qualities equal to Sunhigh, to replace Summercrest. The Peach Council has further requested that an attempt be made to breed a yellow-fleshed commercial peach to ripen 1 week after Elberta and another 2 weeks after Elberta. Good progress is being made.

Rutgers Tomatoes

The steady increase in popularity of the Rutgers tomato is shown by the increased acreage and number of pounds of Rutgers seed (certified) produced in New Jersey since 1935. In 1935, 730 acres of Rutgers seed were included in a total certified acreage of 2,763. In 1943, 3,865 acres were planted to Rutgers out of a total of 5,504 acres. It is also interesting to note that out of 167,462 pounds of certified seed produced in New Jersey in 1943, 113,396 pounds were Rutgers.

Plant certification records in Georgia show that the certified acreage of Rutgers plants in 1940 was 1,418. In 1943, 4,847 acres were in Rutgers out of a total of 6,692 acres surveyed.

The majority of Georgia certified plants were shipped to Maryland, Virginia, Pennsylvania, New York, Ohio, Indiana, Michigan, Illinois, Wisconsin, and into Canada along the Lakes.

VARIETY TESTING

In addition to breeding new plant varieties, the Station is constantly testing varieties developed elsewhere for possible adaptation to New Jersey conditions. In the case of such a plant as peaches, winter hardiness is frequently the deciding factor in determining the usefulness of a new variety in this State.

Until recent years, the only way by which one could determine the relative hardiness of peach buds of different varieties was to await the appearance of a severe winter. Sometimes when that occurred, all peach buds were killed so that no measure of relative hardiness could be obtained.

In 1940, a method was developed at the New Jersey Station in cooperation with the U. S. Department of Agriculture by means of which freezing results with dormant peach buds could be obtained similar to what would be experienced out-of-doors at the same temperatures. This method is now used annually to determine the relative fruit bud hardiness of many varieties and seedlings during the winter months.

From December 20, 1943 to March 1, 1944, a total of 1,937 different peach twig and bud samples were exposed to freezing temperatures and a total of 194,236 fruit buds were sectioned and examined to determine the degree of injury. It had been learned during the winter of 1942-1943 that dormant buds of most of the common standard varieties of peaches on the Station grounds would resist a temperature of 5° to 8° below zero F. and still have enough buds remaining alive to produce a crop.

During the late summer and early winter of 1943, exceptionally dry weather was experienced and during the winter of 1943-1944, the dormant fruit buds of most peaches resisted temperatures of —9° to —11° and still retained enough live buds to produce a crop. When the buds had swelled slightly and had attained the so-called silver bud stage, most of them successfully resisted temperatures close to zero. After the buds had advanced to a point beyond the silver bud stage where portions of sepals and calyces were slightly exposed, most varieties successfully resisted temperatures of 7° to 8° when the rate of temperature fall was relatively slow.

A few of the hardiest named varieties throughout the winter and spring of 1943-1944 were Ambergem, Arp, Carman, Chili, Dewey, Duke of York, Rosebud, and Yellow Greensboro.

This New Jersey method for determining the cold resistance of fruit buds is of special value in determining the relative hardiness at different periods during the winter and the early spring season, for noting the comparative hardiness of the buds of different varieties, and relative hardiness of fruit buds on trees experiencing different nutritional and environmental conditions.

Tift Sudan Grass

Tift sudan grass is a new strain recently developed by the U. S. Department of Agriculture. The summary of trials for 2 years at New Brunswick indicates that this strain surpasses the production of ordinary commercial sudan grass by an average of 500 pounds to the acre.

This new strain appears more valuable for hay than for pasture purposes. It is somewhat slow in starting growth and this would mean deferring grazing longer than is necessary with commercial sudan grass.

Leaf spot diseases are the chief limiting factors in growing sudan grass for hay in New Jersey, since they cause severe leaf browning, resulting in loss of green color and reduction in yield. The Tift sudan grass is highly resistant to the leaf spot diseases, being almost free of them compared with 40 to 50 per cent contamination on sudan grass grown from commercial seed.

Vicland Oats

Extensive tests during the past 3 years show that Vicland, a new oat variety, is well adapted to the oat growing region of New Jersey. It has proved superior in grain production besides being early-maturing and resistant to disease and lodging. It also gives a heavier oat than other popular varieties. The straw yields are light because the plants are short, and this makes it a good variety to use for companion crop purposes in seeding down permanent hay or pasture crops, since it offers less competition to the young grasses and legumes by shading.

You can't get a good variety down! Wong winter barley stood up where another variety couldn't take it in the 1943-44 variety trials at New Brunswick.

When good yields of grain are desired along with an abundance of straw the varieties Keystone, Swedish Select type, and Victory are satisfactory. These varieties will produce 30 per cent more straw than Vicland but Vicland normally produces a heavier oat and, therefore, better quality grain.

Wong Winter Barley

A new winter barley is challenging the leadership of such standard varieties as Maryland Smooth Awn, Nassau, and Tennessee Winter. Wong, an introduction from New York State, is a good yielder, stands well, and is resistant to the mildew disease. Besides producing excellent yields of grain it is a good straw producer. Further studies are in progress with this variety, especially as related to its winter-hardiness.

CULTURAL PRACTICES

Row-Spacing Affects Soybean Yields

Much has been written about row-spacing soybeans for maximum grain production. Such spacing will vary with the

soil type, soil fertility, the rainfall, and the variety. Tests to determine the best row spacing for the two grain soybeans, Granger and Chief, were started in 1943. These two varieties were seeded in replicated rows ranging from 7 to 42 inches apart at 7-inch intervals. Granger is an early-maturing, short, much-branched type of soybean, whereas Chief is medium-maturing, tall, and almost non-branching.

Granger produced highest yields when grown in 7-inch rows, and a continuous decrease in yield resulted as row spaces were widened to 42 inches. The highest yield at 7 inches was 22 bushels per acre and the lowest yield at 42 inches was 12.5 bushels.

Maturity Related to Spacing

Yields from the Chief variety ranged from a high of 26 bushels at 14 inches to 18 bushels at 42 inches. Spacing rows 7 inches apart was too close to give maximum production with this variety.

Moisture tests of the grain taken in early October showed that rate of maturity was also related to row spacing. Chief soybeans planted in 42-inch rows contained only 11 per cent moisture at that time, whereas the grain from rows spaced 7 inches apart had almost 25 per cent moisture. If it is necessary to plant Chief beans late, maturity can be hastened by planting in rows.

Row-spacing also affected lodging. Chief Soybeans were most severely lodged in the 7-inch rows, much less in the 14-inch rows, and in the other spacings hardly at all.

Irrigation for Potatoes

The use of portable irrigation on potatoes again proved its value by increasing potato yields an average of 37 bushels per acre in an experiment at Cranbury in 1943. This yield increase was obtained with only four irrigations. Rainfall records indicate that at least six irrigations should have been applied, and it is reasonable to believe that a much greater yield increase would have resulted if the potatoes had been irrigated six times.

It was also found that, for the most profitable returns under irrigation, Katahdins should be planted 10 inches apart in the row.

Timothy Hay Management

In a 3-year study of timothy hay production as related to fertilizer applications and cutting treatment some significant facts have been uncovered of importance in a permanent grassland type of agriculture. The following fertility treatments were used: (1) No treatment; (2) 400 pounds of 5-10-5; (3) 400 pounds of 5-10-5 plus 200 pounds of sodium nitrate in April; (4) 1200 pounds of 5-10-5; and (5) 400 pounds of 5-10-5 plus 200 pounds of sodium nitrate at early heading. All treatments were applied annually in the spring. Replicated plots receiving the above treatments were cut at three stages of development of the timothy plants: early heading; beginning bloom; and late bloom.

The highest yield from plots cut at early heading was an average of 2,286 pounds of cured hay from those plots receiving 1,200 pounds of 5-10-5 annually. The highest yield at the beginning bloom and late bloom stages was also obtained with this treatment, being 4,567 pounds and 6,123 pounds, respectively. All treatments gave significant increases over the control plots.

Nitrogen Increases Protein

Among the most significant findings from this study are the tremendous increases in yield secured from those plots harvested at beginning bloom and late bloom as compared to early cutting. It is well known that nitrogen applied at the early heading stage, as practiced in treatment 5 above will increase protein content without sacrifice of yield. It merits more wide-spread use on timothy hay fields than has been the case in past years.

As significant as the yields are the records on stand or persistency. Nearly

all the timothy on those plots cut at the early heading stage for three years had disappeared, leaving in its place a stand of almost pure weeds. This indicates that timothy cut continuously at the early heading stage over a period of years is not strong enough to grow vigorously and maintain itself. In a permanent grass system of agriculture this is a highly important discovery. Present recommendations are to cut early for highest quality, but these results show that timothy will not persist over a period of years under this practice.

Highest yields and best quality timothy hay can be obtained by growing timothy on soil well supplied with lime and mineral nutrients, supplemented with nitrogen fertilizer in early spring and again at the early heading stage. The crop should be cut 10 to 20 days after the second application of nitrogen.

Grass-Legume Mixtures Excel for Hay

A 3-year study of grass-legume mixtures for hay shows great promise for new grasses being used in conjunction with alfalfa on fertile, well-drained soils. A mixture of bromegrass and alfalfa produced an average of almost 4 tons of cured hay per acre; alfalfa and orchard grass mixed was almost as good; alta fescue and alfalfa, and timothy and alfalfa were also very productive.

Other mixtures of less value were timothy and alsike, and timothy and red clover. The clovers, however, being biennials were somewhat at a disadvantage in these tests since the third year's cutting was nearly pure timothy. Nevertheless, the clover mixtures averaged slightly over 2 tons of cured hay per acre.

Mixtures distinctly inferior for hay were those in which ladino clover and birdsfoot trefoil were included. It is concluded that ladino is better for pasture than for hay and under the conditions of this test birdsfoot trefoil was not satisfactory for either hay or pasture purposes.

The yields of bromegrass, orchard grass, and timothy in mixture with alfalfa were equal to yields from straight plantings of alfalfa. In addition, the mixture of a grass with alfalfa has a number of distinct advantages, as follows:

(1) Grasses form a protective mulch for the alfalfa, thereby reducing winter-killing.

(2) If a poor stand of alfalfa is obtained the grass often provides good covering and insures a hay crop.

(3) The grass-legume partnership results in a higher quality grass hay since the legume shares with its grass partner the nitrogen it takes from the air.

(4) The grass contributes large quantities of organic matter to the soil and the legume furnishes cheap nitrogen to the farm either from decay of the legume roots in the crop rotation system, or from the manure resulting from feeding the alfalfa to livestock.

(5) Better erosion control is possible because the presence of a grass in mixture with alfalfa provides a denser and firmer sod, more resistant to water runoff than alfalfa grown alone.

New Grasses for Mid-Summer Pasture

The months of July and August are critical periods in the production of nutritious and palatable pasture herbage. Kentucky bluegrass pastures normally dry up and become unproductive, making it necessary for many dairymen to feed part of their winter supply of roughage and concentrate feeds. New grasses now under investigation bid fair to provide more pasturage during this danger period.

Many grasses have been tested for their growth during mid-summer and a number have been found to be greatly superior to Kentucky bluegrass. Rated in order of vigorous mid-summer growth on a fertile upland soil, these grasses are: Tall oat grass, orchard grass, bromegrass, reed canary grass, alta fescue, Kentucky bluegrass, and timothy. Tall oat grass is especially vigorous, making a return growth equal almost to alfalfa.

Orchard Grass Brome Grass Reed Canary Grass

Three good grasses for use in New Jersey. They deserve more widespread use. (See Circular 492, published by the New Jersey Agricultural Experiment Station.)

Better pasture mixtures, using some of these grasses in conjunction with one or more fast-growing legumes, are already being successfully used by some New Jersey dairymen. Such mixtures are equally adapted and valuable for hay or grass-silage purposes.

Mid-Summer Hay

A mixture of soybeans and sudan grass is one of the best emergency summer hay crops. In a 4-year test sudan grass and soybeans mixed yielded an average of 5,532 pounds of 10 per cent protein hay for a return of 553 pounds of protein per acre each year. Soybeans grown alone were almost as valuable, with the average production of cured hay being 4,795 pounds, containing 11 per cent protein, thus yielding 527 pounds of protein per acre. Sudan grass alone averages 5,050 pounds per acre but the protein content of the hay was only 9 per cent. Cowpeas produced an average of 3,187 pounds of cured hay per acre.

Mid-summer hay crops offer a means of securing feed when permanent hay or pasture crops fail. They are also versatile enough so that they can be used for pasture if not needed for hay.

Since these crop seeds are sensitive to cold, they should not be planted until after May 15 in South Jersey and May 25 in North Jersey. Plantings may be made up until early July with good chances of getting a hay crop.

The most important feature in handling mid-summer crops is the time of harvest. The stems of sudan grass and soybean plants are thick and cure slowly at best. Good curing weather is essential and, therefore, the crop should be cut sometime during the last two weeks in August. It should be cured in the swath for one or two days and then raked into windrows to insure saving the leaves.

Supplementary Hay

In a 4-year test of oats with various legumes for hay it was found that a mix-

ture of winter vetch and oats was most productive. This mixture produced, on the average, 4,249 pounds of cured hay per acre. The hay analyzed 9.6 per cent protein, resulting in an average production of 408 pounds of protein per acre. Mixtures of field peas and spring vetch with oats were little better than oats grown alone with average yields of about 3,600 pounds of hay per acre, containing 7.5 per cent protein and yielding about 270 pounds of protein per acre.

The spring hay crop should be sown as early as a good seedbed can be prepared, since late seedings result in corresponding decreases in yield. A mixture of 1½ bushels of oats with 30 pounds of winter vetch has given best results. The vetch seed can be mixed with the oats and the mixture planted with a grain drill. It should be cut for hay promptly when the oat seeds are in the milk stage. This is also a valuable mixture for grass-silage.

Plant Spring Oats Early

Oats is a crop adapted primarily to a cool season. This means that oats must be planted early to be grown with good success in New Jersey. Tests conducted during the past 5 years show that a 10-day delay in planting in April resulted in a 10 per cent reduction in grain yield, and a 20-day delay decreased grain production by more than 30 per cent. A similar, although not as pronounced, reduction in straw yield occurred.

Oats should be planted as early in the spring as it is possible to prepare a good seedbed. Cold spells in April are not severe enough to reduce germination nor to injure young seedlings and need be no cause for delaying plantings. In addition to an increased yield from early plantings, heavier grain with a better test weight is secured, thus improving the feeding quality.

Early plantings of oats, together with the use of an early-maturing variety, such as Victland, will improve quality and increase yields of this valuable grain crop.

Sweet Potato Storage

Tests conducted during the past 3 years have shown that the bruising of sweet potatoes at harvest time increases the likelihood of loss from soft rot. This is especially true when such potatoes are stored in rooms where the temperature ranges from 60 to 70°F. Where the temperature is maintained at 80 to 85°F. and the relative humidity held at approximately 90 per cent during the curing period, the losses from soft rot are reduced to a minimum.

Seed Testing

A plant can be no better in quality than the seed from which it comes, and one of the important duties of the Experiment Station is the testing of seeds and of legume inoculant cultures offered for sale in the State. Some 9,000 to 10,000 separate tests are made annually in pursuance of this duty, and unsatisfactory stocks are ordered removed from the market.

Many requests come to the laboratory each year for information concerning the harvesting and storing of seeds, the location and availability of special types and qualities of seeds, the identification of seeds and weeds.

Boosting Greenhouse Tomato Yields

Studies with the use of growth substances (plant hormones or hormone-like materials) sprayed onto tomato blossoms to supplement natural pollination have shown this practice to be practical and advantageous in greenhouse tomato production. Tomato plants sprayed with some growth substances yield 10 to 15 per cent more fruits than those given the usual hand-pollination treatment.

Although seedless tomatoes usually are smaller in size than seeded fruits, those treated with growth substances to supplement pollination generally are somewhat larger and more uniform than hand-pollinated ones.

One of the growth substances found most effective for this purpose is 2,4 dichlorophenoxyacetic acid. A crop of

greenhouse tomato plants treated with this material requires very slightly less labor than the common pollination practice and usually produces up to 15 per cent greater yields than the latter.

A second growth substance, beta-naphthoxyacetic acid, is very effective in supplementing natural pollination. The use of this material requires slightly more labor than the usual pollination practices, but the increased yield usually warrants the additional labor.

For satisfactory sets of fruits from the use of growth substances, it is necessary that tomato plants be forced to make vigorous growth with thick stems, and thick, dark-green leaves. Plants that are too "hard," with yellow-green leaves and relatively thin stems, often fail to set fruit when their blossoms are sprayed with growth substances.

A Cover Crop for Blueberries

In spite of several unfavorable conditions, a cover crop may be used in blueberry fields to conserve the soil. This land is especially acid, pH 4 to pH 4.8 if it is good blueberry land, and will not support legumes. By testing plants that are acid-tolerant, it has been found that a stand of oats can be obtained if shown about August 20 and properly fertilized. It was necessary to find a crop that would make growth in September and October to be of value and then be killed by the frost so that it would not attract deer in the spring. Deer are very numerous in the blueberry district and devour great numbers of fruit buds when in the berry fields.

Light Intensity Influences Yields

Because of the high degree of control over growth that is possible when plants are grown by gravel culture, this method is being used to study the nutrient requirements of several greenhouse crops. The extremely complex nature of soil makes this medium very difficult to use for such studies. Already the knowledge concerning nutrient needs that has been ascertained from gravel culture has led to substantial increases in yields when applied to soil-grown greenhouse crops.

Experiments of several years' duration have shown that rose plants in gravel culture absorb only approximately half the amounts of nutrients, and produce about half the number of flowers per month during the period from November 1 until March 1, that they do during the remainder of the year. Similarly, the amount of daily light reaching the plants during the late fall and winter months is only about half that of the average for the remainder of the year.

Recent studies with carnations in gravel culture have shown a remarkably close relationship between seasonal light intensity and flower production. Thus, both the yields and the average daily illumination value for the late winter and spring of 1944 were 13 per cent below those of the same period in 1943.

Rooting Geraniums

The geranium is one of the most popular pot plants grown by commercial greenhouses in New Jersey. For a long time it has been customary to root geranium cuttings in sand, then place the rooted cuttings in soil in 2¼-inch pots. Many years ago the cuttings were rooted directly in soil, but this practice was abandoned in favor of rooting in sand because the use of the latter medium resulted in less loss from rot.

Recent investigations at this Experiment Station have shown, however, that unfavorable results from the direct rooting of geranium cuttings in soil are due primarily to the following causes: (1) the use of poorly aerated and dense potting soils, (2) the presence of excessive amounts of nitrogen in heavy soils, (3) the use of cuttings of soft growth status, and (4) the lack of adequate root-promoting substance available to the cuttings.

It has now been adequately demonstrated that potting soils comprising 2 parts of composted soil, 1 part of limed

peat, and 1 or 2 parts of sand, depending on the texture of the composted soil, are well suited for the direct rooting of geranium cuttings. Moreover, the use of a commercial root-promoting preparation enables geranium cuttings to root just as quickly in soil as in sand.

The elimination of the sand propagating bench in rooting geranium cuttings will save many hours and dollars for New Jersey florists.

PEST CONTROL

New Insect Problems

During the year under review two important insect problems have arisen in New Jersey.

The potato tuber worm, *Gnorimoschema operculella* (Zell.), an insect which heretofore had been absent from New Jersey, became established in 1943 and caused severe damage to potato tubers in localized areas in southern New Jersey. Surveys in 1944 have established the fact that the insect is able to survive New Jersey winter conditions and serious trouble may be expected if climatic conditions are favorable for tuber worm development. Severe infestations have been observed on eggplants as well as potatoes.

Although the wheat-head armyworm, *Protoleucania albilinea* (Hbn.), has been known to occur in New Jersey, according to our records the most widespread damage ever caused by the species occurred in the spring of 1944 on barley and wheat. Observations in wheat and barley fields in southern New Jersey show that from 50 to 80 per cent of the crop in the infested fields was destroyed by this insect.

Helping Farmers Get Insecticides

When the war began our sources of supplies of some of the important insecticides were seized by the enemy. We not only lost our source of these insecticides but the demands of the armed forces have required a large part of the available supplies. These combined factors have created a very serious shortage in pyrethrum and rotenone products for agricultural uses. In order to stretch the available supplies a cooperative program between the Federal Bureau of Entomology and Plant Quarantine and the various State experiment stations on pre-determining the needs of the various localities before the insect problems become acute has made it possible to shift supplies of the critical insecticides from one section of the country to another to meet the demands of the various districts.

This cooperative effort has greatly benefitted New Jersey growers. For example, in one area of the state rotenone supplies were very low and serious insect damage threatened to occur. When the needs of this particular area were known we were able to get immediate shipments of rotenone in the area and loss from insect damage was prevented. A similar situation was encountered with nicotine, and after learning our needs the War Food Administration and War Production Board allocated nicotine supplies for the area.

Progress in Codling Moth Control

The codling moth, one of the most destructive fruit insects in the country, has been a serious threat to the New Jersey apple industry. Recent experiments and experiments now in progress indicate that DDT (dichlorodiphenyl trichlorethane) may become an important weapon against this serious fruit pest. The results on early-maturing varieties of apples show that DDT at the rate of 1 pound to 100 gallons of water is 10 to 15 times more efficient than the regular arsenate-of-lead program. Before we permit our hopes to rise too high, however, it is necessary to have all the facts regarding the effects of DDT on the apple tree and on the consumer of the apples sprayed with it.

This material also gives outstanding promise as an insecticide against the Oriental fruit moth.

Protecting Newly-Set Tomato Plants

Transplanted seedlings undergo a tre-

mendous shock when they are pulled from the plant beds and transplanted to the field. To lighten this shock plants should be given every care possible. In case of tomato plants, especially in southern New Jersey, they are seriously affected by such foliage-feeding insects as the Colorado potato beetle and potato flea beetle.

During the past 2 years a study on methods of protecting newly-set plants against the ravages of foliage-feeding insects has been in progress. Although we have had only 2 years' experience with this type of protection, five experiments in various parts of the state indicate that southern-grown, as well as home-grown, plants can be dipped in a spray mixture before transplanting with promising success from the standpoint of protection against insects as well as against drying out of the foliage.

Although a fairly large number of insecticides have been tested, a dip composed of ½ pound of acid lead arsenate in 15 gallons of water plus enough summer oil emulsion to give ¼ of 1% actual oil in the mixture, is the most promising mixture tested to date. There is some evidence that the small amount of summer oil emulsion reduces transpiration, thus giving the plants a greater opportunity to become established in their new location.

Pea Aphid

Peas have been considered a very uncertain crop for New Jersey conditions for many years. During the past 5 years, however, we have accumulated data which show that good crops can be grown provided the peas are protected against the ravages of the pea aphid. Also during this period extensive experimentation on methods of combatting the aphid has demonstrated the merits of rotenone sprays and dusts and also combinations of rotenone and nicotine. Although nicotine is a very toxic insecticide, it does not possess the residual action of the rotenone materials. Rotenone insecticides do not give immediate spectacular results but they do stop the insects from feeding immediately and after a few days the aphids are completely destroyed. Throughout the course of these studies the untreated check plots have been worthless while the plots on which pea aphid control was effected show excellent yields of high-quality peas. Pea aphid control is very reasonable in cost and the growers cannot afford to take chances on escaping aphid infestations.

European Corn Borer

Much has been said and written about the European corn borer on corn. This insect is becoming of increasing importance to New Jersey agriculture. Since the corn borer first became established in New Jersey the annual infestations continue to increase and as yet we have no indication that the peak of abundance has been reached or is in sight. Because of the increasing abundance of corn borer our efforts to find means of curbing its damage have been increased. New types of insecticides have been tested against the corn borer on sweet corn and promising results have been obtained, even with a reduced insecticide program.

Experiments are now under way to determine the effects of European corn borer infestations on potato yields. Experiments are also under way on the possibility of re-arranging the potato pest control program in such a way as to prevent or reduce infestations in the potato crop.

Oriental Fruit Moth

A cooperative experiment between the Experiment Station, the State Department of Agriculture and the Peach Industry Committee of the New Jersey State Horticultural Society has been established to determine the effectiveness and the efficiency of parasites in controlling Oriental fruit moth. Prior to 1943 we had no means of producing parasites in quantity early enough in the season for liberations on the first generation of the Oriental fruit moth. Consequently, all previous work has been based on liberations with parasites against the second and third generation of fruit moth.

Several years' study of this problem shows that the Oriental fruit moth infestation in ripe peaches can be materially reduced by the important larval parasite, *Macrocentrus ancylivorus*. One of the most important purposes of the present experiment is to determine the efficiency of the parasites when liberated against the first generation of the Oriental fruit moth. Although it is too early to draw definite conclusions we have indications that a reduced number of parasites liberated on the first generation of moths may be as effective as a larger number liberated against the later generations.

Spray Coverage of Apple Trees

Studies on the completeness of spray coverage in apple orchards show that many growers do not apply their sprays evenly on the trees. In some cases, as much as 70 per cent more spray was applied to the lower sections of the trees than to the top sections, and as a result, a heavy infestation of insects and diseases was found in the top sections of the trees. There was not much correlation between the method of spraying and evenness of coverage in the tops and bottoms of the trees. Even distribution of spray materials appears to depend on the efficiency of the man applying it, rather than on the method used.

Arsenical Injury

The problem of arsenical injury to fruit trees from spray materials has been serious in many orchards. In a laboratory experiment the spray materials, such as skim milk powder, hydrated lime, arsenate of lead, and sulphur, were added to water in various orders, and the mixture after standing for a short time was analyzed for water-soluble arsenic.

The experiments were repeated, using different types of sulphur and other fungicides.

The study showed that the order of mixing has not so much effect as the individual constituents of the spray material upon making the lead arsenate become water soluble. It was found that lime-sulphur caused the greatest amount of water soluble arsenic, and that the lime caused a reduction of the solubility of the arsenic. Additions of manganese sulphate and zinc sulphate also caused a reduction in arsenic solubility, provided lime was also present. When bordeaux mixture is to be made in the spray tank, the copper sulphate and lime should be added before the other constituents.

Blueberry Stunt

The rapidly expanding blueberry industry of New Jersey is menaced by "stunt," a virus disease for which control methods have not yet been demonstrated. This problem is being attacked in active cooperation with the U. S. Department of Agriculture. The project is in charge of a pathologist from the latter Department, who is working to define the symptoms of stunt on different varieties of blueberries and at various seasons of the year; to identify distinct strains of this and other viruses on blueberries; and to determine the rate of spread of stunt in the field under various conditions.

The Blueberry Research Laboratory has concentrated much of its effort on finding a control for stunt. Tests are under way to discover possible insect vectors. A spray mixture has been compounded that, when applied to diseased bushes, will kill any insects present and will also kill the foliage and roots of the bushes so that they can no longer serve to spread the disease. Roguing programs are being carried out in several fields to determine the effectiveness of this method of control. Field schools have been held to teach growers to inspect and rogue their own fields.

Blueberry Weevil

Blueberry weevil was more destructive in unsprayed fields in 1944 than for many years back. This offered an especially good opportunity for checking on a large scale

the effectiveness of the spray treatment recently recommended by the Blueberry Laboratory. Spraying accomplished control in all cases known or reported. In one field where less than a half-crop had been obtained every year for the past five years, the pest was thoroughly cleaned up and a crop of 100 bushels to the acre was harvested.

Saving Copper

Because of a threatened shortage of copper fungicides brought about by the war, an experiment was conducted using reduced quantities of copper sulphate in bordeaux sprays for potatoes. It was found that concentrations of bordeaux sprays ranging from 6 to 8 or 10 pounds of copper sulphate with 10 pounds of hydrated lime per 100 gallons of water were equally effective in repelling insect pests of potatoes, and produced equal yields. No diseases were encountered during the test, but experimental work in other states indicates that bordeaux mixtures containing 8 pounds of copper sulphate to 100 gallons of water will give adequate protection against early and late blight, provided the plants are thoroughly covered at proper intervals. The use of 8 instead of the customary 10 pounds of copper sulphate to 100 gallons of spray would save approximately 150 tons of copper sulphate per year on New Jersey potato farms.

Livestock Research Program Covers More Than 20 Breeds

MORE than a score of breeds of warm-blooded animals may be found in the barns, pastures, ranges, and laboratories of the Experiment Station, reflecting both the diversity of agricultural pursuits in New Jersey and the breadth of the supporting research program. Four-footed species range from cows and steers to laboratory rats and guinea pigs; feathered species include pigeons, turkeys, and various breeds of chickens. Greatest attention, naturally, is given to cows and chickens, which represent the state's two leading types of farming.

Among the services rendered to all branches of livestock farming is the continuous inspection of commercial feeding stuffs offered for sale in the state. Matching the wartime increase in farm production, the year's records show total sales of 597,000 tons of feeding stuffs for the 1943 season, the largest tonnage on record.

Wartime shortages of many feeding materials complicated the task of the manufacturer and necessitated considerable latitude in enforcement of the feed control laws. Manufacturers were permitted to substitute ingredients in their registered feeds, so long as correct guarantees were attached to the feeds as sold. Failure to change these guarantees to correspond with changes in feed composition was probably the largest single factor responsible for the deficiencies found in 312 of the 1,297 official samples examined during the year.

These cows—two of the outstanding individuals in the Experiment Station herd at Beemerville—produced a total of 149,520 pounds of milk and 5,487 pounds of butterfat in their first five lactations. They have each had five calves from artificial insemination.

DAIRY CATTLE

Inbreeding vs. Outbreeding

Some of the practical applications of our attempt to improve Holstein cattle through various methods of breeding were summarized during the year. In a recent publication (Bulletin 712) we reported that butterfat test can be increased without reducing production. This should be good news to dairymen who no doubt will be expected to produce high-testing milk when the stress of war demand for milk is returned to normal. The study also revealed a remarkable ability of certain females to transmit many characteristics, including milk with high fat percentage, to their progeny, irrespective of the sires used.

The primary contribution of the inbreeding work, thus far, lies in the development of superior sires. These sires, because of their inbreeding and selection, have apparently had fixed in their germ plasm a high degree of prepotency for high test, and are able to pass this on to their progeny with twice the rate of their outbred brothers. Such sires are invaluable in our artificial breeding program, as dairymen are assured of definite increase of fat percentage among cows in their herds that are descended from these inbred bulls.

Artificial Breeding Pays

A fat production increase of 14 per cent and a milk production increase of 9.3 per cent have been noted in the first generations of artificially bred heifers in New Jersey. One hundred and twenty heifers owned by 112 members of New Jersey cooperative breeding associations gave 734 pounds of milk and 42.2 pounds of fat more than their mothers at the same age.

The ability of Holstein sires to transmit increased fat percentage to their daughters is reflected in the 14 per cent increase in fat compared with the 9.3 per cent increase in milk.

This inherent factor for increased test has been developed by the Station's Hol-

stein breeding experiment at the Dairy Research Farm.

Rental Plan for Bulls

Directors of New Jersey's Artificial Breeding Unit No. 1 have now been operating nearly a year on a base rental plan for lease of herd sires, recommended by the Experiment Station. Under this plan the base charge for selected proved sires is $3 per semen sample collected by the technician at the breeding unit. To this basic charge is added a further allowance based upon the average production of the sire's daughters, compared to the breed average for age and type of record. In the New Jersey Breeding Unit this extra allowance is 10 cents for each percentage point by which the daughters' records exceed the breed record. For example; if the daughters of a bull average 450 pounds of fat and the breed average is 410, then dividing 450 by 410 we get 109, or 9 per cent above the breed average. Thus the total charge should be $3.90 per sample semen. Unproved bulls are being leased on the basis of their pedigrees, allowing for age and records shown in the first two generations of the ancestors.

This method of lease places emphasis on performance, and a sire earns according to his ability to produce progeny of high quality.

Mastitis Resistance May be Inherited

In a study of the existence of mastitis in two cow families at the New Jersey Station, evidence was found to support the theory that some cows are more susceptible to this infection than others.

Under the same conditions one family of six cows including a dam, two daughters, and two granddaughters were infected 39.3 per cent of the milking time. On the other hand, family 247 composed of the dam, four daughters, and two granddaughters were infected only 10 per cent of the milking time.

Bang's Disease Control

During the past year the Bang's disease studies have been increased in scope. Following an outbreak of this disease on the Dairy Research Farm at Sussex, a program of adult vaccination was instituted in this herd. Using a method which was reported by another state, research workers injected a small amount of the strain No. 19 vaccine into the skin of the adults instead of using the larger dose under the skin—the method which has been recommended for calves.

Although it is too early to draw any definite conclusions, results at the end of the first year indicate that this method has afforded some protection against the disease. Also the animals treated by this method are returning to negative at a more rapid rate than would be expected when the large dose is injected under the skin.

Attempts are under way to develop a new method for measuring the immunity imparted to the animals by the vaccination.

Growing Dairy Replacements

As the result of winter feeding experiments to study growth response and pasture experiments to study this same problem in raising dairy replacements, some interesting conclusions have been reached:

(1) It takes a lot of expensive grain to fatten a yearling heifer;

(2) Feeding a yearling heifer all the good silage and hay she can consume produces good growth and thrifty condition, but not a fat animal;

(3) When these animals are turned out on good pasture in the spring the fat yearling declines in weight rather rapidly for the first month, whereas the growthy, roughage-raised yearling gains in weight and condition rapidly;

(4) Good roughage plus good pasture produces the most economical replacements. No poor quality roughage is good enough for any dairy animal, be it heifer, cow, or bull.

Alfalfa Silage Preserved with Corn Meal

An experiment was conducted to de-

termine whether it was possible to make a complete ration out of alfalfa silage preserved with corn meal, and field-cured hay. The nutrients needed to maintain a thousand-pound cow producing 40 pounds of 4 per cent milk were calculated. It was found that 480 pounds of corn meal had to be added per ton of green alfalfa so that when 50 pounds of silage was fed with 10 pounds of hay the calculated requirements could be met.

From previous experimental work reported in the literature it was assumed that corn meal in going through the ensiling process lost none of its feeding value. Because of this report the experiment was established.

The silage was of excellent quality but when fed at the rate of 50 pounds a day with 11 pounds of mixed hay it was impossible to hold a 40-pound average production. Further chemical studies showed a loss of more than 10 per cent of the nutrients in the corn meal in addition to the normal silage fermentation losses.

When using corn meal as a preservative for grass silage it is not economical to use more than 250 pounds per ton of green alfalfa. At this level the nutrient loss within the corn itself is held within the range of normal fermentation losses in the ensiling process, and the silage is of excellent quality.

Tests of protective coatings for cement silo staves against the destructive action of silage acids now include more than 50 materials. Most of these have been exposed to at least four filling cycles. Coatings include special cements, a range in types of varnish and enamel, oils, phenolic resins, coal tar, and asphalt derivatives. No material tested to date has given perfect results. Coatings that are at all sticky result in silage adherence and the subsequent removal of large patches of coating. Penetrating type coatings resist the mechanical and chemical action of silage somewhat better than surface treatment. In many cases, failure of coating was caused by initial failure of the cement wash coat used originally as an inside finish for the silo. This suggests the possibility that protective coatings might better be applied directly to the staves, in which case they should be of such a nature as to seal the pores thoroughly. It seems desirable to plan on renewal of protective coatings at intervals of three to four years rather than to depend on indefinite coating effectiveness. Of those tested, the acid-resistant varnish-type enamels and raw linseed oil seem to represent the two leading treatments.

POULTRY

Legbar Breeding

The further development of the Legbar breed has featured the poultry breeding work during the year. A tentative breed standard has been worked out for this new kind of domestic fowl, including descriptions of plumage pattern, colors of feathers in the various sections (for its particolored plumage), size, and form. The 1944 matings were made on the basis of these tentative standard requirements; about 300 Legbar pullets, the 1944 crop, attest to advancement in the production of a more uniform type of fowl.

The breed still maintains the differentiating down-color by which the sexes of day-old chicks may be accurately determined by observation. The Legbar will breed true with respect to this autosexing characteristic, thus differing from first-generation cross-matings previously used for day-old sex-linked inheritance chicks.

It has been found that dark hens with distinct salmon breasts tend to produce highest percentages of dark-down chicks with distinctive striping. The trend is for these Legbar pullets and hens to produce nearly white-shelled eggs. Selection for a pure white shell will be continued.

The Legbars thus far bred have resembled the Leghorn in type and size. In further development of this breed, however, a larger size of fowl will be sought.

Pullets on Experimental Ranges at New Brunswick.

The objective is to present a utility fowl, of pure breeding, which in addition to being an efficient producer of white-shelled eggs, quick-growing broilers, and high-quality meat, will possess the desired autosexing feature—combining all these attributes in a fowl of beauty and good lines.

Jersey Buff Turkeys

At the Turkey Research Farm, the fifth and sixth generation matings incident to the development of the Station's new, small-bodied, quick-maturing, broad-breasted, buff-colored turkey were made and studied. Cross-matings were made with excellent specimens of straight broad-breasted turkey stock from the Pacific Coast, in order to introduce more of this desired feature into the local strain. Material progress has been made; and the breeding season of 1944 indicates that the new breed, to be offered to eastern growers as one peculiarly well adapted to their type of turkey industry, is now advancing from the experimental to the commercial stage.

This new breed is to be called the Jersey Buff turkey. Trial shipments of hatching eggs and day-old poults were offered to New Jersey growers for field tests, at prevailing charges for such products, during the spring of 1944. More will be made available in 1945. About 100 breeder hens were used at Millville during this past spring.

Of special interest has been the project dealing with the production of "turkey broilers." These have been defined as young turkeys, at about 7 pounds live weight and about 12 weeks of age. Data on the cost of production will be studied, interpreted in terms of something like normal costs, and presented in bulletin form in the coming year. These young turkeys presented a remarkably well-meated carcass, dressed advantageously and easily, and were found, by several tests, to be succulent, extremely tender, juicy, and delicious. Like most young

The new Jersey Buff Turkey, broad-breasted, quick-maturing and fine-flavored, is tailored to fit the needs of small families. This breed produces excellent broilers weighing about 7 pounds on the hoof at 12 weeks of age.

meats, these turkey broilers did not seem to possess a distinctive flavor which would resemble that of the mature fowl.

Turkey broilers might interest growers who (1) find it necessary to reduce the numbers of young stock on range or at hand during the midsummer period; (2) desire to present a delectable, different, and high-quality meat product to discriminating customers at a season when there is generally a dearth of quality poultry meat; and (3) wish to cater to a certain type of retail trade which might like this broiler particularly well and raise no objection to paying a reasonably high price for it.

Poultry Disease Work

Investigations relating to poultry diseases and parasites have continued to be a major line of work within the poultry department.

During the year ending June 30, 1944, the laboratories at New Brunswick and Vineland received a total of 13,945 specimens from 3,894 farms for diagnosis. This represents an increase of 157 cases and 1,066 autopsies over the previous year.

The lack of interest of the veterinary profession in poultry practice leaves the industry, in most places, without adequate protection. Consequently, the Station's diagnostic service is especially useful. The primary purpose of the diagnostic service, however, is to keep the Station in touch with current diseases and particularly to identify new parasites and infections as they appear. In the past, a deadly foreign disease (fowl plague) has appeared twice, and its early identification paved the way to prompt eradication. The first of these outbreaks involved several states, but the second was, fortunately, diagnosed early and the slaughter of affected and exposed birds eradicated the disease before it got beyond the county.

Thus the routine examinations indicate the diseases existing in the state and incidentally benefit the poultrymen who present them. In the same way that the Station draws from the publications of others, the reports on new diseases are of benefit to other pathologists who might encounter them. Moreover, the diagnoses serve as a basis for planning research projects.

Every year some new findings can be pointed to, and though many of these are of minor importance, the sum total of information over a period of years results in a valuable collection of data.

During the past year the findings of importance were: an outbreak of equine encephalomyelitis in pheasants in the absence of any reported cases in horses; pullorum infection in pheasants; tuberculosis in a pigeon; several types of *Salmonella* from various species of birds; *Tetrameres* sp. *and Cosmocephalus obselatus* from the proventriculus of a herring gull; a nematode, *Porrocaecum ensicaudatum,* and a fluke of the family *Dicrocoelidae,* from the grackle; a skin fluke, *Collyriculum faba,* from a brown thrasher; two flukes *Cryptocotyle lingua* and *Himasthea quissetenosis,* from the intestines of herring gulls; a tick, *Ixodes brunneus* from a snow bird; two natural cases of malaria *(Plosmodium cathemerium)* in canaries; and finally, the observation that carbolineum causes poisoning in poultry.

A second project was mainly concerned with the study of laryngotracheitis. Two strains of this virus are propagated in embryonated eggs, one of recent isolation and another that has now been through 137 passages. A study of this latter strain will determine whether long passage through eggs affects the virulence of the virus or its immunizing properties, since it is known that some viruses become modified with continued propagation.

Thus, a strain of bronchitis virus has been carried in eggs for years and now after 160 generations has lost both virulence and immunizing properties for chickens while still exhibiting greater virulence for embryos than the sixtieth passage of the same virus passed less frequently.

In the same study there is a strain of fowl pox and pigeon pox and each is passed in hen and duck eggs. The object is to determine any modifying effect by passage in duck eggs. With pigeon virus passed in duck eggs a vaccine is made and has been used on two field flocks of turkeys and chickens with good results so far.

Two strains of canary pox are also carried in eggs, and vaccine made from these is supplied to a large canary breeder who, in turn, supplies immunized birds to laboratories investigating malaria.

Two as yet unidentified strains of virus are being carried and will be identified.

Wartme Poultry Feeding

Early in the year the poultry staff prepared a special bulletin on "Wartime Poultry Feeding," several thousands of copies of which were distributed throughout the state's poultry industry. Suggestions were offered as to substitutes which might be used in the event that usual foodstuffs became scarce or too high in price. Recommendations were included for improved feeding practices, and for ways and means of eliminating waste in poultry feeding. Copies of this bulletin are still available; and its contents will be most useful for the duration.

During the year, current poultry feeding problems have been studied from several angles. It has been found that restricting grain feeding to adult fowls to one hour daily, either from 8 to 9 a. m. or from 4 to 5 p. m., with the grain available in open hoppers, resulted in an increase in the ratio of mash to grain consumed without lowering total feed consumption, and with better egg yields in the pens where the grain feeding was restricted. This result is important, in view of the grain scarcity. It was found also that cooked soybeans could be fed to laying flocks in lieu of usual laying

mash, in emergency, without fear of material drops in egg production.

Various grass mixtures have been tested for poultry ranges. There are indications that hens ranged on succulent grass crops or legumes could be carried over on mashes containing reduced amounts of usual proteins and vitamins — at least, as a war emergency measure. Likewise, mashes for pullets could safely be reduced, if the birds were ranged on green pastures. An interesting point was brought out in these range studies—the best crops for the hens usually looked the worst in the fields, because the hens kept those greens eaten down close. The greens accomplish results only if the fowls consume them while they are green, succulent, and full of juices.

Under an industrial fellowship project it was clearly demonstrated during the year that previous recommendations as to limestone requirements of laying fowls have been too low. Better yields and stronger shells (meaning much less breakage and loss) were obtained when pullet layers were allowed free access to soluble limestone grit and when as much as 7 per cent of limestone flour was added to the laying mash. These results will be presented in detail in a forthcoming bulletin.

Vitamin A Studies

A practical all-mash ration, containing between 1,000 and 1,200 units of vitamin A per pound, gave adequate growth with White Leghorn chicks. The vitamin A was supplied entirely as the plant forms, carotene and cryptoxanthin, and was furnished by 30 per cent of yellow corn meal and 1 per cent of alfalfa in the diet. As rather large variations were found in the vitamin A content of different samples of these ingredients, it is not possible to state that these levels of corn and alfalfa will always furnish enough of the vitamin.

Hens received an adequate amount of vitamin A from equal parts of mash, containing 30 per cent yellow corn meal and 4 per cent alfalfa, and scratch grains containing equal parts of cracked corn and wheat. Such rations were found to contain 2,000 to 4,000 units of vitamin A per pound of mash and 500 to 1,500 units per pound of scratch grains. Over a period of 8 months the average carotene content of the whole ration fell between 1,500 and 2,000 units per pound of feed.

The wartime shortage of fish liver oils as a source of vitamin A, the inadequate supply of yellow corn, and the scarcity and low quality of alfalfa have all directed attention to the possible necessity for other sources of this important vitamin for poultry feeding. Although extra labor would be necessary, it is within the realm of practicality to obtain supplementary vitamin A by the use of wheat or oat seedlings, grown in daylight from sprouted grains to a height of 4 to 6 inches. One pound of whole seedlings contains 4,000 to 6,000 International Units of provitamin A (carotene) and when fed at the rate of 5 pounds per hundred birds daily, approximately one-third of the daily recommended allowance will be satisfied. The use of chlorinated lime to control excessive mold formation during the growth of seedlings was not found harmful to laying birds.

Layers Will Stand Crowding

Because of a desire to carry a maximum number of layers in existing poultry houses, some poultrymen have raised the question as to whether or not the old rule of "4 square feet of floor area for every layer" might not be relaxed. Three flocks were carried through the winter, one with 4 square feet to a bird, one with 3 square feet, and one with only 2. All flocks were of the same line of breeding and of the same hatch. Production was essentially the same in each lot for the winter and spring seasons.

In the most crowded pen the litter was changed somewhat more frequently, as would be expected. These results will be presented in detail in bulletin form later; but it appears that poultrymen may safely

allow one hen to each 3 square feet of floor area, and probably, if sufficient care in management is practiced, a rate of one fowl to each 2½ square feet of floor area can be used.

In this way poultrymen may be able to increase their layer holdings sufficiently to meet wartime and postwar needs for more layers without materially adding to existing structures. Management of flocks thus more intensively housed will be studied further. It is logical to assume that when an increased number of fowls is enclosed within a given floor area the daily care and management of those fowls may be increased, and even changed in form and amount.

Poultry Housing

As the war period advances and as studies are being made in postwar problems, poultrymen begin to ask about repairs and additions to poultry houses and about new types of poultry houses.

During the past year, field experiments based on two new ideas in poultry housing have been made at New Brunswick: one dealt with a house having a semi-round roof made of an asbestos board; and the second, with a field range shelter with a roof of the same asbestos material. The first structure, used in the form of a colony brooder house, or as a laying house for a flock of about 50 hens, has appeared to be advantageous in several respects: (1) Its form provides plenty of head room; (2) it can be easily set up through use of prefabricated sections: (3) it is neat and attractive in appearance; (4) it has considerable insulating value and needs no painting or other treatment. This type of building may be seen more and more in postwar farm poultry buildings. The second structure is providing good protection against the summer sun, and needs no painting.

Probably there will be a decided trend to standardize poultry house designs for the postwar period. The N. J. Multiple Unit Laying House idea, originated 30 years ago, may be a basic starting point in the evolution of the economical postwar chicken house.

The practicability of using masonry construction for poultry houses was proved last year in a 3-pen test house and feed room built in cooperation with a Somerset County farmer. Except for the roof, window and door frames, and interior fittings, the entire house is constructed of masonry units. A unique ventilation system admits air through vertical holes in the front wall blocks, discharging at window-sill level inside the house for uniform, draftless incoming air supply. Air is exhausted through the standard type of rafter ventilation system at the front of the low-pitched shed-type roof. The cinder blocks representing wall construction were treated inside and out with a brush coat of sand and cement mortar and finished with a neat wash coat of waterproof cement. Floors are of concrete. Dropping pits replace the usual dropping-board construction. Litter remained dry on the floor throughout the difficult winter season. With lumber scarce and high in price, poultrymen have shown a great deal of interest in the possibilities of masonry construction. This test house offers assurance that correctly designed poultry houses of masonry construction will give satisfactory performance.

Flock Mating Tests

In addition to the standard egg-laying tests the Station has instituted what has been called the "Flock Mating Project," operated in connection with the Passaic County test. The first project came to a close in September, 1943. Entries of pullets were restricted to chicks hatched from 100 eggs selected at random on the owner's premises, thereby representing a fairly good cross-section of the stock as bred and reared by the respective poultrymen. The winning pen of 16 pullets completed a year without any mortality. It was the only one of the 14 competing pens with that record.

Production for the year averaged 246 eggs per bird. The value of all eggs, sold at wholesale market prices, was $143. During the year the increased meat value of the birds in the pen amounted to $6, thus adding that amount to the gross income of the entry. After $40 was deducted for feed cost, the return was $109. On a comparable basis the return of the poorest pen was $25 and the average of all pens $79.

The widespread difference between the lowest and the highest pens is some measure of the great differences that exist on poultry farms and indicates the economic importance of the life of the fowl prior to the age of 6 months. After that age all birds in this project received the same feed, care, management, and the results obtained were due to conditions existing before the birds reached laying age.

New Slant on Culling

In an effort to reduce the amounts of poultry feeds needed, it has been the practice of some poultrymen to cull their laying flocks heavily, on a monthly basis. Though removal of uneconomical layers is advisable, especially in these times, wholesale culling may result in the disposal of hens which would ultimately add materially to the nation's total food production through later egg yields. A study of the egg records of 736 pullets entered in the Hunterdon Egg-Laying Test during the year 1935-36 leads to the following conclusions:

1. Birds pausing (for 21 days) in egg production in the October-February period should not be culled because they laid at a profitable level for the rest of the year.
2. Birds pausing in egg production in the March-September period should be culled as detected.
3. Total egg production with no culling was 10,966 dozens, which gives a return over feed cost of $2,966.
4. Total egg production with monthly culling throughout the year would have been 7,719 dozens, with a return over feed cost of $2,345.

OTHER LIVESTOCK

An Extra Crop of Lambs

Though sheep production is not a large enterprise in New Jersey, it can be made a profitable side line on general farms because the eastern market will pay a premium for locally grown lambs of the right weight and finish. Many farmers feel, however, that the birth of only one lamb a year requires too much feed for such a small return. With this thought in mind it seemed desirable to determine the possibility of inducing estrum in ewes during the spring and to determine whether the ewes would conceive following this artificially induced estrum.

In the first trial, ten ewes, 3 and 4 years old, were injected with 5 cc. of gonadin. Six of the ten lambed the following fall. Twenty-five yearling ewes were also injected, and five of these lambed in the fall. The 11 ewes which had lambed in the fall bred normally the same fall and lambed again in the spring. These ewes after weaning their lambs were bred again in the fall of the second year, giving three crops of lambs in 2 years. This project has been enlarged this year in cooperation with the owner of a large commercial farm flock who has made about 100 ewes available for study under normal farm conditions.

Milk Production of Beef Cows

In beef production, the early gains are the cheapest, and the beef cattle producer is interested to know whether his brood cows are producing sufficient milk to raise a calf and also whether he can raise the level of milk production so as to get a larger calf at weaning time. With this in mind, an investigation has been started to be carried through a period of years to determine whether a thyroprotein compound included in the feed will increase the milk flow for the brood cow so that larger gains will be made by the calves during the nursing period.

Numerous experiments have demon-

strated the ability of a thyroprotein to increase the level of milk and milk fat production in dairy cattle. Most of these experiments were of short duration, and it was desirable to determine whether thyroprotein could be fed safely over a long period of time.

One cow was fed thyroprotein for 16 consecutive months, and seven cows were fed thyroprotein from 3 to 8 months. No harmful influence was noted either during or following the prolonged feeding.

Nutritional Detective Work

Further confirmation has been obtained during the year of the value of an as yet unknown substance in meat scrap which is of value in the growth of nursling white rats. It is entirely possible that it is this substance which makes meat scrap, tankage, and fish meal so much desired in the rations of swine, and possibly also in poultry rations for good hatchability and growth of chicks.

OYSTERS

Oysters and the War Effort

Much emphasis is laid upon the contribution of the fisheries to the nation's food supply. And justly so, for here alone among our food resources does man reap where he has not sown, as he gathers in the finny fishes which migrate up and down our coastline. With shellfish we also gather of Nature's bounty hard and soft clams and scallops, putting nothing back into the water.

North of Chesapeake Bay he who gathers oysters must also sow. He plants his shells, gathers his seed, transplants his oysters to growing grounds and finally to fattening grounds to prepare them for market. He is in truth an underwater farmer. The annual oyster crop in this country approximates 90 million pounds of meats; meats returned to us from nutrients otherwise lost to the sea from the land. In this very important conservation harvest New Jersey now stands fourth among the states of the nation.

We consider the meats of the oyster and their contribution to the nation's food supply, while usually overlooking the valuable shells. These are planted back on the beds to secure a set of seed oysters, or are ground up and sold to poultry farmers as chicken grit. The value of oyster shells sold each year in this country is close to $1,500,000. We must therefore add the weight of shells to that of the oyster meats in computing the pounds produced each year. With this addition we find that oysters stand first among this nation's fisheries, exceeding even the huge annual salmon catch.

The importance of oyster shells to the poultry industry must be stressed at this time. The demand for chicken grit this year is so heavy that many a pile of oyster shells destined for planting upon oyster-producing bottoms has been ground up for poultry feeding. At Bivalve, one plant is rapidly reducing a pile of more than 300,000 bushels of shells to high-grade chicken grit. In normal times this pile of shells would have gone overboard. Oyster shells contain much more than the mere lime necessary for egg shells. Many other elements and compounds, such as iodine and phosphates, are present, at least some of which are important in maintaining the health, growth, and egg-laying capacity of the hen. The humble oyster, therefore, though unable to speak for itself, can justly claim some of the credit for this nation's record output of eggs.

"Fattening" Oysters for Market

The oyster stores its excess of food not as fat, as in most other animals, but as glycogen. Small amounts of oil obtained from certain food organisms also are stored, helping to give the oyster its distinctive flavor and raising its content of vitamin A. Microscopic plants known as diatoms are of major importance in the nutrition of oysters. The shallow water tidal flats of the Cape May shores of Delaware Bay support an abundant dia-

Three hundred thousand bushels of oyster shells at a shell-grinding plant at Bivalve being turned into chicken grit. A contribution from the sea to the poultry industry. November, 1944.

tom life. Oysters transplanted here show distinct improvement within a week. In a month's time oysters so poor as to be unmarketable can be so improved as to rank among the better stock in shell trade. In the summer of 1944 three shiploads of very poor oysters were brought to these flats where oyster food is unusually abundant. The experiment is being carried out as a cooperative project of an important oyster grower of the Maurice River Cove area and of the experiment Station's Oyster Research Laboratory. Preliminary results have been most promising, the oyster meats more than doubling in volume in one month.

Transplanting "Corn on the Cob" Set

The exceedingly dense sets of better than 600 oyster spat per square inch obtained each year on the Cape May shores of Delaware Bay have never been utilized commercially. Growth is so rapid and competition so keen that the oyster shells are paper thin. When these thin-shelled oysters are transplanted to deeper waters, crabs, drills and other enemies make short work of them. During the summer of 1943, shells were exposed to setting in wire bags, and the set moved to deep water when 2 weeks or less in age. In the new location much scaling off of young oysters occurred, and now after only one year a fine bed of rapidly growing, well-shaped oysters has developed. Some of the largest of these oysters are just under 3 inches long, a phenomenal growth for one year in northern waters.

By using this method of early transplanting, the wire bags are overboard for only 2 weeks and may be used year after year, thus amortizing the cost over an extended period. Each shell catches many times the set it would when on the bottom. thus greatly increasing efficiency. With competition for shells from our rapidly expanding poultry industry, fewer shells must be made to do the work of many. One of the largest planters in Maurice River Cove plans to plant up to 5,000 bushels of shells in bags during the summer of 1945.

Serving the People of New Jersey

ABOUT 76,000 farm workers are needed at the peak of the production and harvesting seasons in New Jersey. Of this number about 35,000 are on farms or in the neighborhood; another 30,000 are recruited from within the state, and 11,000 come from outside the state. On April 29, 1943, the President signed the Emergency Farm Labor Act, delegating to the Extension Service the job of labor placement on farms. Federal funds were thus made available to supplement a special state appropriation previously made to get a farm labor placement program under way.

A field staff was organized with headquarters at New Brunswick and with representatives in the various counties whose job it was to obtain labor and place it where the need was greatest. Three labor camps were set up in southern New Jersey to house about 2,000 Jamaican laborers. Business men, school boys, women, and girls were also pressed into service. A total of 5,881 farmers placed 15,785 orders for farm help during that first season. The records show that 4,651 farmers, or 79 per cent of those requesting help, received it, and that 14,420, or 91 per cent, of the orders were filled.

Congress extended the program on substantially the same basis for 1944, with indications that the need would be as great as in 1943.

Wartime Responsibilities

Many other emergency administrative duties have devolved upon county agents and extension specialists to add to the pressure under which they are striving to assist farmers in the production of record quantities of food despite scarcities of labor and machinery, gasoline and rubber, equipment and supplies.

In each agricultural county, rationing committees have been established under the County Agricultural War Boards. In most counties, the agricultural agents were called upon to assist in organizing these committees and, in many cases, to serve as their secretaries. One such committee in each county is in charge of farm machinery rationing. Some 20,000 applications for farm machinery were acted upon by these committees during the year. A transportation committee in each county is charged with the allocation of farm trucks and tires and extra gasoline. Approximately 215 truck applications were approved last year. A farm building committee in each county receives farmers' applications for lumber, hardware, electrical equipment and other restricted materials in connection with all major repairs to farm houses or buildings. More than 400 building applications came before these committees during the year.

Farm Building Services

Despite building restrictions, the demand on the Extension Service for farm building plans and advisory service continued heavy. Among the 924 blueprint plans for farm structures distributed during the year, nearly 500 were related to poultry farming, 140 represented dairy barn plans, and the remainder represented hog and horse barns, cribs, and crop and implement storage structures. Personal assistance was given to 35 dairy farmers in planning new barns or remodelling old ones; 59 poultrymen received special help in connection with their construction problems; and 37 farm calls were made to

advise on fruit and vegetable storage plans and construction. In many cases, such assistance has resulted in appreciable savings in construction costs over original intentions.

Testing Paints

Five years ago a fence was erected at New Brunswick with direct southern exposure for the purpose of solving a variety of paint problems of particular interest to farmers. The project was undertaken in cooperation with the Cornell Experiment Station and the G-L-F Exchange. The various panels have been subjected to periodic inspection through the 5-year period.

Among the findings at this stage, it appears that the kind of wood may be an important factor in paint failure. Some paints failed much sooner on pine than they did on cedar; other paints, particularly the barn reds, did about as well on pine as on cedar.

Substitution of soybean oil for a portion of the linseed oil was also tried out, since at the time the test was started there was a trend in this direction. It appears that up to 25 per cent by weight of the linseed oil in white paint can be replaced by soybean oil without affecting performance unfavorably. The barn red tests are not yet complete, but indications are that an even higher proportion of soybean oil can be used satisfactorily in these paints.

Victory Gardens

The fall of 1943 saw an intensive Victory Garden program carried to a successful conclusion, with vast quantities of home-produced food in the larders of New Jersey families, both rural and urban. For 1944, the nation called for a 25 per cent increase in garden production, to be obtained by increasing the number, size, and efficiency of home gardens.

As in the previous season, the Experiment Station, College of Agriculture, and Extension Service were called upon to administer the educational phases of the effort. Meetings, community short courses, press, radio, and instructional literature were utilized, as in the previous year.

Early in the season it became apparent that the demand for our services would not be so heavy as in 1943. This was due partly to the fact that the major educational job had been done the year before. Then too, there was not the same incentive as in 1943 because of the removal of commercially canned vegetables from the ration lists in the early winter. Early surveys indicated that there might be an increase in Victory Gardens, but final reports showed that there were 10 to 15 per cent fewer gardens, although it was reported that many who had gardens in 1943 had larger gardens in 1944. Comments from several sources are to the effect that the general level of skill in gardening was higher in 1944 than last year.

Nevertheless, there can be no question that New Jersey did not meet the requested 25 per cent increase in production. A deficiency in soil moisture carried over from late 1943 was not fully overcome by spring rains, and a severe midseason drought affected virtually every section of the state, causing serious reduction in normal yields wherever artificial watering could not be employed.

Another reflection of the wartime food situation was a marked increase in correspondence concerning the cutting and curing of various types of meat. This may be attributed in part to the increase in the number of local freezing plants in the state and in part to more home processing of animals raised on the farm.

Looking ahead, it seems clear that the educational task has been largely accomplished for the duration, and that the work of the institution with home gardeners can be restored to a service basis, to be handled in the main by the continued distribution of literature. Many persons have doubtless gained a new appreciation of working with plants, and it is to be expected that in years to come New Jersey homes will be more beautiful, both out-

doors and in, as this war-born interest in gardening is diverted from food to flowers and shrubs.

Fruit Processing

Both home and commercial canners are keenly interested in turning out a product that will be attractive to eye and palate. Recent studies have shown that there is a marked difference among varieties of fruits and vegetables in their adaptation to canning and other methods of processing. This becomes a matter of interest to the farmer as well as the processor and consumer, since it tends to affect the marketability of his products.

Investigations of this subject have therefore been initiated in the Station laboratories. About 700 samples of fruit representing a large number of varieties were processed experimentally during the year by quick-freezing and various methods of heat processing.

The Garden State nectarine, a New Jersey introduction, proved to be especially well adapted to freezing. Flavor and appearance were both improved if the nectarines were frozen in halves with the skin on. When they were canned with the skin on, however, the red pigment faded, and the product was not so attractive as when the fruit was peeled. The following New Jersey peach varieties proved to be especially well adapted to quick-freezing: Eclipse, Goldeneast, Pacemaker, Sunhigh, and Triogem.

The use of the correct amount of sugar was found to be especially important in bringing out the best peach flavor. A rather undesirable strawy taste was evident in both canned and frozen peaches when the sugar content was slightly below optimum. With most varieties a 40 per cent sirup was sufficient to prevent this undesirable flavor, although with other varieties at least a 50 per cent sirup was desirable. A few low-acid seedling varieties gave a fairly satisfactory canned product without any sugar. This particular type of peach is of special interest to persons who can take very little sugar in their diet.

The browning of the fruit after it thaws is one of the most important problems in connection with quick-freezing of peaches. The ideal solution would be varieties that do not turn brown on exposure to the air. Fruit of one peach seedling, as yet unnamed, was still of bright color, with no undesirable browning, after having been thawed and exposed to the air overnight. Various methods to prevent browning were studied. Slicing the peaches directly into cold sirup and keeping them covered with sirup after thawing until they are served is a simple and useful method, although it will not completely prevent browning very long after the fruit thaws.

Blueberries and blackberries made a very satisfactory frozen product. Blueberries covered with a 30 per cent sirup had better texture and flavor than those frozen with dry sugar or no sugar at all. Blackberries, after having been frozen with 50 per cent sirup, and then thawed, were found to have lost much of their tart, bitter taste and were, in the opinion of several observers, more desirable than the fresh fruit.

The importance of the proper degree of maturity for canning peaches was well demonstrated. Elberta peaches picked when they were hard ripe were inferior in flavor and appearance to those which were tree-ripened. Fruit which was so ripe that it dropped normally, although delicious for eating out of hand, was not so good canned as was tree-ripened fruit picked directly from the tree.

HEALTH

An important, and growing, place in the Station's program is occupied by activities related in one way or another to the safeguarding of human health. Mosquito control, sewage treatment, and water supply problems have been under study in our laboratories for many years. More recently, the microbiologists have been drawn into this field.

Mosquitoes

New Jersey, one of the first states in the country to undertake mosquito control work on an extensive scale, began its program more than 40 years ago because the citizens demanded relief from the great pest which made it virtually impossible to stay out-of-doors during the summer months, and which was preventing the development of many natural advantages of the state. Throughout the new densely populated residential districts of northeastern New Jersey mosquitoes were then so numerous as to discourage prospective home owners from building in otherwise highly desirable locations; in the metropolitan section industries were subject to interference resulting from attack upon their personnel by hordes of mosquitoes; in many farming districts labor and animals alike suffered annoyance by the pest; and on the seashore, there were few places where it was possible for resort developments to make normal progress.

Twelve counties formerly subject to the annoyance produced by hordes of mosquitoes are now engaged in a unified mosquito control program, coordinated by the Experiment Station. These comprise Sussex, Morris, Passaic, Bergen, Hudson, Essex, Union, Middlesex, Monmouth, Ocean, Atlantic, and Cape May. It is estimated that the reduction of mosquito breeding on the salt marsh areas alone has allowed the adjacent industrial, residential, and shore resort property to increase in taxable values $555,000,000 more than could have been expected if the mosquitoes had been left uncontrolled. Realizing the benefits that have accrued to these counties, one additional county has recently begun some antimosquito work, and another is now considering the adoption of a control program.

The Experiment Station has always encouraged the utilization of permanent methods of mosquito control, including filling, ditching, diking, and tide-gating and the use of efficient machinery for the performance of routine operations. Accordingly, although war shortages of experienced labor now make it more difficult to keep the work on a normal schedule, the operation of the permanent works, supplemented by the use of machines and such hand labor as can be obtained for temporary control by spraying, has yielded good results.

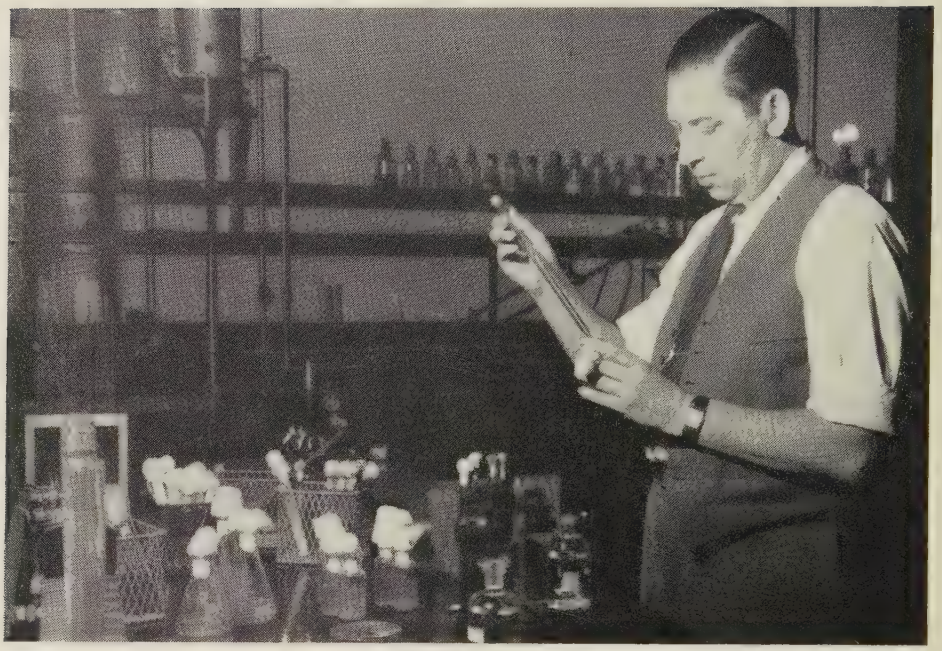
Measuring Mosquito Abundance

Mechanical traps developed by the Experiment Station for standardized mosquito survey and measurement purposes are operated nightly over the state. Forty-one traps operated in 1943 show that there were only one fifth as many mosquitoes on the wing where mosquito control work is being done as in the areas without mosquito control. Thirty-two traps in the protected zone caught an average of 19.5 mosquitoes per trap nightly, while 9 traps in unprotected sections caught an average of 94.3.

Though the mosquito work of New Jersey has been directed against pest mosquitoes generally, it has brought about a vast reduction in the numbers of *Anopheles quadrimaculatus,* the one New Jersey species which can transmit malaria.

Larvicides and Repellents

Oil is the most widely used mosquito larvicide, but in some places it is objectionable, and other larvicides must be used. The Station had perfected an effective material for use in such places, but this involved the use of pyrethrum, now no longer available to civilian agencies because of the military demands which must be met from the limited supplies available. The Station has now developed a substitute material which is available in concentrated form under the designation "New Jersey Mosquito Larvicide #2." It has certain advantages similar to those of the pyrethrum larvicide: (1) the amount of material which must be transported is reduced to one tenth of the amount of oil which would be needed; (2) fire hazard is



Running purity tests on drinking water in the New Jersey Agricultural Experiment Station laboratories.

avoided; (3) injury to vegetation is reduced.

During the past year the Station has continued its research work aimed toward the development and improvement of insect repellents for the armed forces. Cooperative efforts with various government agencies have been expanded to include a research investigation requested by one of the interested agencies. This latter project is aimed toward the treatment of soldiers' clothes to prevent biting through of disease-bearing or pest insects.

Use of repellents to prevent transmission of disease by insects, particularly malaria-carrying mosquitoes, has become an accepted practice wherever the army is exposed to such danger. With the advance and expansion of our forces in localities where such insects abound, research and developmental work on insect repellents assumes increased importance.

Sewage Filter Studies

Purification of sewage on trickling filters has been practiced for many years, and these low-rate filters are considered standard. During the last few years a new type of high-rate filter has come into use. The first of this kind of filter in the state was built at a large army camp. This gave the Station the opportunity to study the relative efficiency and mechanisms of purification of both types of filters. A study lasting over a year has shown certain differences. In general, the low-rate filters produce a higher degree of purification than high-rate filters. The degree of stabilization is higher in low-rate filters, but the quantities of sewage treated are materially less. Reduction of *B. coli* is about 80 per cent in the high-rate filter and about 97 per cent in the low-rate filter. Destruction of organic matter, including grease, is greater in the high-rate filter.

Laundry Wastes

One of the most common wastes present in sewage comes from laundries. Municipal sewage plants must handle it, and plants serving institutions and commercial laundries often receive large quantities throughout the entire week. To determine the most economical method of handling and treating the waste, information available was collected and experimental work conducted showing that various procedures or combinations can be followed. In general, if pretreatment is necessary, best results can be obtained at the municipal or institutional sewage plants where personnel familiar with and equipment suitable for such treatment are available. Laundry wastes alone can be treated economically to any desired degree of purification.

Use of Lime in Sewage Treatment

A study made of the properties, structure, size, solubility, and other characteristics of hydrated lime showed that lime in solution is better for reaction control in digesters and for sewage clarification than lime slurries or dry lime. Using part of the sewage to make the solution has been recommended for operation. For equal clarification and removal of oxygen-demanding materials, lime in solution is lower in cost than any other coagulant or combination of coagulants.

Nitrates in Streams

Nitrates are found in clean and polluted streams. Previous attempts to correlate the quantities of nitrates found in surface waters with the degree of pollution have failed. Results obtained on polluted streams over a period of years now show that the quantities of nitrates present are not dependent upon the degree of pollution, that the temperature of the water is of minor importance, that the quantities of nitrates are materially higher in winter than in summer, and that the quantities of nitrates can be correlated with the volume of water in the stream. During and after rains, the amounts of nitrates increase. The character of the drainage area affects the amounts of nitrates increase. The charter of the drainage area affects the amounts of nitrates present.

Antibiotic Substances

The ability of various groups of microorganisms, largely occurring in the soil, to inhibit the growth of and to destroy disease-producing bacteria has excited great interest during the last two or three years on the part of manufacturers of drugs and chemicals, as well as on the part of public health and medical authorities. This interest has been chiefly due to the fact that two important chemical agents, gramicidin and penicillin, have been isolated from two typical groups of soil organisms and have been utilized for the control of various diseases in man and in animals.

Six other compounds, with similar properties, have been isolated in the Station's microbiology laboratories. These are actinomycin, clavacin, fumigacin, streptothricin, streptomycin, and chaetomin. Of these six compounds, the first two proved to be extremely toxic and, therefore, were found to offer little promise as chemotherapeutic agents. Two of the above compounds, streptothricin and streptomycin, both of which are produced by soil actinomycetes, were found to offer distinct promise for the treatment of various human and animal diseases. These two substances are of particular importance, because they act upon a variety of gram-negative bacteria not affected by any other known substances and also because they possess only limited toxicity to animals.

Since gramicidin and penicillin act largely upon gram-positive bacteria, the ability of streptothricin and streptomycin to attack such organisms as *Shigella dysenteriae,* the cause of human dysentery, *Eberthella typhosa,* the cause of typhoid fever; *Proteus vulgaris* and *Pseudomonas aeruginosa,* causing serious wound *infections*; *Salmonella schöttmulleri,* the cause of certain types of food poisoning; *Shigella gallinarum,* the cause of fowl typhoid;

Dr. Selman A. Waksman and his associates in the new department of microbiology are isolating substances from the soil which may have far-reaching effects in the field of medicine.

Brucello abortus, the cause of abortion in cattle; *Pasteurella tularensis,* the cause of tularemio; *Mycoliae terium tuberculosis,* the cause of tuberculosis, and many other groups of gram-negative bacteria causing important human and animal diseases, is of great theoretical and practical significance. A number of industrial organizations are now engaged in an effort to produce these two substances on a large enough scale so that they can be used not only for the treatment of experimental animals, but also clinically in the treatment of certain human infections. Various medical institutes and governmental laboratories are engaged in testing the activity of streptomycin and streptothricin in the human and in the animal body.

Bacterial Corrosion of Iron

As reported last year, a special group of bacteria is responsible for destruction of steel and cast iron in certain soils. This type of corrosion is commonly encountered in wet land where the ground water stagnates. It is most common in heavy soils, but it may also be encountered in sandy soils, provided conditions are strongly reducing. Unlike rusting, the metal does not become coated with red or brown iron oxides, but there appears a black coating of iron sulfide which may be in the form of a scale or a soft graphite-like material. The soil is also generally mottled and shows areas of blackening.

Investigations carried on during the past 12 months have indicated that anaerobic

iron corrosion is widespread. It may be responsible for destruction of both steel and cast iron, and all kinds of iron structures buried in soil are susceptible to attack, particularly pipe lines which are buried considerably below the soil surface. Most severe corrosion is commonly encountered in regions where there is evidence of decomposition of organic matter in the soil about the corroding iron. Recent results, however, indicate that although corrosion is accelerated where plant materials are undergoing decomposition, the bacteria responsible for corrosion are able to grow on the products coming from the iron itself even though there is no organic material to serve as a source of food for these bacteria. Consequently, this type of corrosion may be encountered over widespread areas, provided conditions are strongly reducing in the soil and the soil reaction is close to neutrality.

As information on these bacteria accumulates, it becomes increasingly clear that they are far more important agents of corrosion than has hitherto been realized. Not only do they attack the exterior of pipes, but they can also corrode the inside in cases where the metal surface is protected from oxygen contained in the water by rust or other deposits on the metal surface.

Fat from Yeast

During the course of studies of soil microorganisms, an interesting organism was obtained which produces large amounts of fat and has possibilities of being used for commercial fat production. The organism, which is widely distributed in soils, is a yeast with many unusual characteristics and, so far as has been determined, is unlike any of the numerous yeasts previously described. When grown under suitable conditions, each yeast cell is almost entirely filled with a large single fat globule. The fat is not extracted directly by fat solvents, but is readily extracted after the yeast is treated with dilute acid.

Under favorable conditions, 20 per cent or more of the carbohydrate consumed by the yeast is converted into yeast cells. These cells contain from 55 to more than 60 per cent fat. Thus the efficiency of conversion of carbohydrate to fat is between 10 and 15 per cent. Greatest fat production occurs when the yeast is grown on media containing small amounts of nitrogen. The yeast is remarkable in that there are few if any other microorganisms which are able to produce such a high fat content.

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Roy James Ferree
William McKinley Foote
Douglas William Friend
Donald Miller Goss
Westervelt Griffin
Paul Edward Hamer
Donald George Hotchkiss
Merritt Huntington
Edward Jensen
*Henry Jensen
Albert Raymond Kemp
Joseph Robert Kenny
William Frederick Koenig
Robert Patrick Logan
Thomas Christopher Longnecker
Cancy Fred Lorenzo
George Washington Luke
John Joseph Mayernik
Alfred Nelson Meiss
Everett Moore
*Alvin Leigh Pardun
Frank Perri
Ebert Lavard Pierce
Aaron Posner
Leonora Helen Pugh
Allen Walker Purdy
Mary Louise Race
Francis Alvin Raymaley
Edgar Terhune Savidge, Jr.
Albert Israel Schatz
Donald Coombe Scott
William Scott
Martin Sherman
Samuel Siegel
Anthony Smolar
Howard Bennett Sprague
Robert Steele
Ernest James Thomas
Stephen John Toth
Jack Vetter
George Merrill Ward
Olive Wells Warner
Edith Mae Wegner
John H. Whipple
George Erwin Whitham
Eleanor Anna Wiesner
Mary Louise Wygant
Wasley Donald Yushok

*Killed in action

Treasurer's Report

Irving E. Quackenboss, in account with the New Jersey State Agricultural Experiment Station, July 1, 1943 to June 30, 1944.

SUMMARY

Appropriations	$568,303.88
Allotment from the General State Fund	50,995.00
Total	$619,298.88

ANALYSIS OF ALL EXPENDITURES

Salaries and Wages	425,454.74
Pension Contribution for Employees on Military Leave	599.23
Miscellaneous Hour and Day Labor	18,753.45
Binding Publications	180.00
Coal	3,749.66
Dairy Farmhouse Supplies	32.65
Development and Operation of Mosquito Traps	344.16
Dues in Scientific Organizations	62.00
Exhibit Expenses including Payment of Premiums	11,999.79
Express, Freight and Cartage	324.20
Feed	35,528.85
Fertilizer	5,730.95
Fuel Oil	2,545.13
Gasoline and Oil for Tractors and other Farm Machinery	1,195.48
Insurance	747.37
Laboratory and Field Apparatus and Supplies	13,557.78
Laundry Service	280.80
Light, Power and Gas	11,188.95
Medical Services	212.75
Motor Vehicle Supplies and Repairs	6,398.96
Photographic Service	366.45
Postage	3,211.83
Post Office Box Rent	24.00
Printing Bulletins and Circulars	8,668.99
Registration of Animals	188.35
Rental of Garages and Parking Fees	597.00
Rental of Land and Buildings	357.00
Repairs and Alterations to Buildings	5,101.20
Repairs to Equipment	2,733.21
Seeds	1,195.70
Stationery	3,410.80
Storage of Boat	21.00
Subscriptions to Periodicals	924.68
Telephone and Telegraph	4,952.20
Traveling Expenses	6,984.60
Veterinary Services and Medicine	574.85
Water	866.72
	$579,065.48
Amount reserved by Purchase Order for Laboratory Apparatus	65.00
Amount reserved by Purchase Order for Additional Farm Equipment	359.60
Amount reverting to State Treasury	39,808.80
Total	$619,298.88

Comptroller's Report

RUTGERS UNIVERSITY

Expenditures under Hatch, Adams, Purnell, and Bankhead-Jones Acts
Fiscal Year Ended June 30, 1944

	Hatch	Adams	Purnell	Bankhead Jones
Personal Services	$12,703.21	$13,823.92	$53,872.66	$24,444.07
Travel	204.98	35.25	1,231.78	333.50
Transportation of Things			11.80	6.93
Communication Service	4.25		24.13	
Rents and Utility Services	24.00		73.00	209.00
Printing and Binding	1,495.32		82.66	396.49
Contractual Services	121.52	20.85	523.03	31.83
Supplies and Materials	379.25	942.98	3,095.94	5,461.85
Equipment	67.47	162.50	985.00	376.65
Lands and Structures (Contractual)		14.50	100.00	
Totals	$15,000.00	$15,000.00	$60,000.00	$31,260.32